

Cosmic Alignment and Social Shift: Reinterpreting Temple-Settlement Morphology in Central Java's Living Sacred Landscape

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Abstract

This study examines the spatial differences between the cosmological orientations of Hindu-Buddhist temples and the evolving settlement patterns in Central Java. The focus of this research is on temples that are still considered sacred and actively used for religious rituals, such as Borobudur, Pawon, and Mendut (Buddhist), and Cetho and Suku (Hindu), which are closely linked to the settlement patterns of their surrounding areas. In comparison, the temples exhibit a symbolically directed orientation—generally toward the east, mountains, or sacred rivers—the surrounding settlement patterns now follow more pragmatic considerations such as accessibility, land economy, and tourism development. Methodologically, the study employs a qualitative-descriptive approach supported by Geographic Information System (GIS)-based spatial techniques using Google Earth. Azimuth analysis, overlay interpretation, and viewshed approximation are applied to examine temple orientations, settlement morphologies, and their symbolic relations to sacred topography. The concept of "social shift" is introduced to explain this gradual spatial deviation. This study strengthens the discourse on sacred landscape transformation. It offers an integrative heritage planning approach, taking into account the relationship between symbolic order and the spatial adaptation of modern society.

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INTRODUCTION

The traditional landscape of Central Java, Indonesia, is home to numerous ancient temples (locally known as *candi*) that have served as spiritual and ritual centers for over a millennium. Built at the height of the Hindu-Buddhist kingdoms between the 8th and 10th centuries CE, these structures reflect sophisticated architectural traditions, cosmologies, and spatial concepts. Among the 16 restored Hindu temples and 10 restored Buddhist temples, two (Cetho and Suku temples in Karanganyar Regency) and three (Mendut, Pawon, and Borobudur temples in Magelang Regency) are still considered sacred today, as they continue to function as regular places of worship. Their continued sacred role positions these temples not only as archaeological relics but also as living heritage spaces that remain active in cultural and religious life, even internationally, such as Borobudur during the Vesak celebrations.

Geographically, Central Java is located on Indonesia's most populous island, Java. This region is characterized by fertile volcanic plains, river systems, and sacred mountains and ranges such as Mount Merapi, Mount Merbabu, Mount Sumbing, Mount Sindoro, and the Menoreh Mountains, which hold spiritual and cosmological significance for Buddhists. Furthermore, Mount Lawu is highly sacred to Hindus and Javanese. These natural features, with their spiritual and cosmological significance, have significantly influenced the typology and morphology of religious buildings and the spatial organization of settlements. Temples are often located parallel to geomorphic elements such as rivers and mountains, reflecting a sacred cosmological order rooted in Hindu-Buddhist spatial logic (Degroot, 2009). The physical orientation of temples often faces east or toward sacred peaks, where this not only serves a

symbolic purpose but also dictates the movement, hierarchy, and ritual geography of the surrounding landscape. Architecturally, the typology of these temples reveals formal, axial, and hierarchical compositions that encode cosmological meanings, such as a mandala layout or a symbolic ascent to the divine. This spatial layout shapes the morphology of surrounding settlements, where human habitation is often structured around or related to sacred sites (Soekmono, 1973). Early village patterns, access routes, and territorial boundaries often align with the presence of temples, establishing a layered sacred-profane spatial dynamic (Jordaan, 1996). Temples were never built haphazardly: their location, orientation, and form reflected the spiritual world. Mountains were considered the axis mundi, the axis connecting the human world and the divine world. In the context of living heritage, awareness of the connection between temples and mountains as spiritual centers remains alive in local rituals and interpretations.

However, in recent decades, these spatial relationships have undergone significant transformation. Urban expansion, tourism development, agricultural intensification, and changing religious demographics have contributed to the fragmentation and reorganization of this sacred landscape (Hillier & Hanson, 1984). A heterogeneous, function-driven urban-rural interface has increasingly replaced the traditional morphology of temple-centered settlements. As a result, the symbolic orientation of temples and their role as spiritual anchors have been progressively marginalized in everyday spatial practices (Nas, 2002).

Numerous studies have been conducted on the symbolic orientation of sacred buildings, particularly in the fields of archaeological and architectural history. However, very few have examined their spatial and morphological opposition to modern domestic patterns, particularly in the case of temples still in active religious use and under pressure from contemporary spatial transformations. This article aims to fill this gap by analyzing the spatial relationship between temple orientation and the morphology of contemporary settlements in Central Java. By combining spatial, typological, and morphological analytical approaches, this study seeks to understand how the logic of sacred space persists, transforms, or shifts in the context of ongoing socio-spatial change. It examines the spatial relationship between temple orientation and settlement morphology in Central Java, with a particular focus on temples that retain their religious function, as living heritage, not only holds historical value but also becomes a field of contestation between symbolic space and contemporary socio-economic demands.

LITERATURE REVIEW

Sacred Landscapes and Cosmological Spatiality

Sacred landscapes spatially reflect the cosmological values and beliefs held by a community. This concept illustrates how spatial order aims to demonstrate the interconnectedness between humans, nature, and transcendent powers. The formation of sacred space occurs through a process of hierophany, the embodiment of holiness in a profane environment, which then produces a cosmological center or axis mundi. The axis mundi is a concept that describes the center point of the world, where heaven and earth meet, and serves as a link between the physical and spiritual dimensions. This concept appears in various cultures and is often associated with sacred places, such as mountains, trees, temples, or specific architectural structures (Eliade, 1959). In Hindu and Buddhist cultures, Mount Meru (Hindu) and Mandala (Buddhist) are considered the axis mundi, the center of the cosmos that connects the human world with the world of the gods. In the realm of architecture, the importance of sacred orientation, namely the way humans imbue space with meaning by considering the direction and symbolic relationship to the sky or certain natural phenomena, is recognized (Norberg-Schulz, 1980). This approach is the basis for understanding the layout of temples and settlements in Java as a system of meaning that is structurally arranged in space.

Temple Orientation in Hindu-Buddhist Java

Temples in Central Java exhibit orientation patterns that not only follow astronomical orientations, but also cosmological and contextual ones. Studies by Soekmono (1973) and Jordaan (1996) show that the orientations of temples such as Borobudur, Mendut, and Pawon exhibit linear relationships that are not coincidental but reflect specific processional paths or cosmological directions. A study by Degroot (2009) even mentions the possibility of a connection between temple orientation and astronomical phenomena such as the rising of the sun at certain equinoxes. This indicates that orientation is not merely a result of technical considerations, but rather a representation of royal cosmology and ritual function. This aligns with Priatman's (2000) view that the orientation and layout of buildings in tropical regions often take into account the sun's path and awareness of solar energy, which, in sacred architecture, contributes to a complex symbolic and spiritual spatial experience (Priatman, 2000)

Settlement Patterns and Spatial Logic in Java

In Austronesian traditions (including Javanese), houses serve not only as residences but also as centers of social life, cosmological symbols, and markers of kinship (cultural) identity. The structure and spatial layout of a house

reflect human relationships with ancestors, the cosmos, and social hierarchies (Fox, 1993). Although their forms vary across regions, there is a common understanding that the house is both a vessel for life and a symbolic representation of culture, which is also evident in the morphology of the settlements. The relationship between temples and settlements reflects traditional spatial patterns rooted in the social structure and cosmological belief systems of Javanese society. Geographical anthropological studies indicate that traditional societies organize settlements based on the cardinal directions, water sources, and the location of sacred sites (Tuan, 1977).

In Java, north-south and east-west orientations are often associated with spiritual significance, particularly in the Hindu-Buddhist and Javanese traditions (influenced by animist beliefs). Meanwhile, research on settlement morphology revealed that the direction of houses, roads, and village centers can be related to the orientation of temples or mountains (Ikhsan, Setioko, & Suprapti, 2022). Thus, spatial arrangements are not only based on technical aspects but also contain symbolic and ideological meanings. This concept shows how humans in various cultures seek to understand and connect with the universe through places considered sacred. Research by Damayanti *et al.* (2005) strengthens this finding by showing how the spatial patterns of traditional Javanese cities, such as Yogyakarta and Surakarta, are shaped by the cosmological principles of mandala and *imago mundi*, where the center of power and spatial orientation are formed based on symbolic relationships with mountains and the sky (Damayanti & Handinoto, 2005).

Recent studies on traditional settlements also emphasize the inseparability of everyday intangible cultural practices from tangible spatial forms. Rituals, beliefs, and cultural customs are integrated into architectural forms, spatial arrangements, and environmental contexts, thus shaping settlement identities (Guoqing, Binqing, Jie, & Lie, 2023). This framework highlights how settlement identities continue to be shaped by cosmological orientations and socio-spatial adaptations, offering a useful perspective for analyzing the morphology of Central Javanese temple-settlements as part of a living heritage system.

Sacred Landscape Transformation in Contemporary Contexts

Social change, urbanization, and tourism development have influenced how communities understand and utilize sacred landscapes. The concept of living heritage, proposed by UNESCO, highlights the importance of interpreting cultural heritage in a contemporary context, including how sacred elements adapt to modern dynamics.

Cities, villages, and settlements in Indonesia cannot be understood as static entities, but rather as socio-cultural processes that are constantly in dynamic motion, yet remain imbued with spatial symbolism (Nas, 2002). In the context of cultural landscapes and sacred landscapes in Central Java, the cosmological orientation of temples often shapes settlement patterns and serves as a symbol of collective identity, as Nas has argued about the notion of urban symbolism, where monuments/sites and public spaces are often considered representations of the "spirit of the city." However, the dynamic development of settlements often becomes an arena of contestation, where religious, national, and global values negotiate, transform, and even eliminate each other (Silverman, 2011). This is evident in the temples, which serve as spiritual centers and world heritage icons, with their cosmological significance now interacting with national narratives, tourism, and global interests, ultimately influencing the development of surrounding settlements. The morphology of settlements around temples can be understood as a living sacred landscape that is constantly being negotiated, on the one hand maintaining traditional cosmology, while on the other hand experiencing social shifts due to contemporary socio-economic and political changes. In line with this opinion, the process of negotiation, where local traditions adapt, resist, or evolve in the face of global influences, is a key characteristic of cultural transformation in Indonesian society (Fauzan, 2025).

These various studies demonstrate that temple and settlement orientations are inextricably linked to the cosmological structures and social dynamics that shape them. However, cross-temporal studies examining how these orientations change or are maintained within the context of social shifts are still limited. This article aims to fill this gap by reexamining temple-settlement orientations in Central Java through an integrative approach combining cosmology, spatial anthropology, and geospatial analysis.

METHODS

Study Area

This research examines five temple sites in Central Java, Indonesia: the Buddhist temples of Mendut, Pawon, and Borobudur, as well as the Hindu temples of Cetho and Suku. These temples are known for their enduring religious functions and spatial connections to sacred topographical features such as Mount Merapi, Mount Merbabu, and Mount Lawu. The study area includes the temple sites and the surrounding settlement patterns that have historically developed around these religious landmarks.

Types and Sources of Data

The study utilizes secondary data, which includes:

- Literature sources such as academic books, journal articles, archaeological reports, and historical studies focusing on Hindu-Buddhist cosmology, temple orientation, and traditional spatial structures in Javanese architecture.
- Geospatial data, obtained through Google Earth, including satellite imagery and coordinate-based mapping of temple locations and surrounding settlement areas.

Analytical Techniques

This research employs a qualitative-descriptive approach by observation and secondary data, supported by basic Geographic Information System (GIS)-based spatial analysis, conducted primarily through tools available in Google Earth. The spatial analysis techniques include:

- Azimuth and orientation analysis, to determine the directional alignment of each temple axis concerning cardinal points and key geographical landmarks.
- Overlay analysis by visually interpreting the spatial relationship between temple positions and settlement structures as seen in satellite imagery.
- Viewshed approximation, using visual line-of-sight analysis to interpret potential visual connections between temples and significant natural features (e.g., mountains, rivers).
- Buffer zone estimation, through scaled visual measurements to examine the spatial influence range around each temple complex.

These spatial techniques are interpreted through a symbolic framework rooted in Hindu-Buddhist cosmology and Javanese sacred landscape concepts, particularly concerning spatial order, orientation, and sacredness in architectural expression.

Limitations

The research does not include field-based surveys or interviews. All spatial analysis is conducted using publicly accessible tools and imagery from Google Earth, which, while limited in precision compared to advanced GIS software, is sufficient for the interpretative and exploratory nature of this study. The findings are therefore presented in a qualitative and symbolic analytical framework, rather than quantitative or statistically modeled outcomes.

RESULTS AND DISCUSSION

The orientation patterns of temples in Java are often closely linked to the surrounding settlement patterns. Temples do not stand alone, but rather form part of a cultural landscape that reflects the social, economic, and religious systems of the community. Here are some key connections:






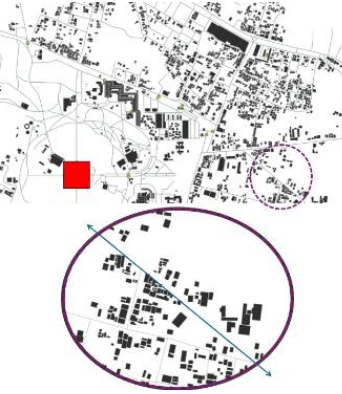
- **Hierarchical Structure.** Settlements around temples often follow a hierarchical pattern, where the center of power or place of worship is at the highest or most sacred point, while community settlements are spread around it in a pattern that reflects social status (Setyohadi, 2007).
- **Connectedness with Nature.** Many temples in Java were built with natural elements such as rivers, mountains, or the direction of the sun in mind. This also influenced settlement patterns, with villages often following river courses or being located on mountain slopes to support daily life (Maulidi, 2021).
- **Procession and Ritual Route.** Some temples have orientations that reflect religious procession routes. Settlements around temples often developed along these routes, creating spatial patterns that supported the community's ritual and economic activities (Harriyadi, 2023).
- **Spatial Patterns and Social Segregation.** In some cases, settlement patterns indicate social segregation, with elites or nobles living closer to the temples, while the general population resided further away. This reflects the social structure of the kingdom and the temple's role as a spiritual and administrative center (Setyohadi, 2007).

Thus, the orientation of the temple not only functions as a symbol of the kingdom's cosmology but also forms a settlement pattern that reflects the relationship between humans, nature, and beliefs.

This change is an indicator of a social shift, where the spiritual and symbolic meaning of space is shifting towards an economic orientation, accessibility, and infrastructure, particularly under pressure from tourism. This dynamic aligns with the research of Li et al. (2023), which suggests that traditional settlements embody a dual chain of cultural and landscape "genes," where intangible rituals and culture, as well as the evolution of spatial order, are formed simultaneously (Guoqing, Binqing, Jie, & Lie, 2023). Through this perspective, it is appropriate in the Javanese context to examine how cosmological harmony persists as cultural memory, while settlement morphology adapts pragmatically to modern socio-economic pressures.

Table 1. STUDY TRANSITION: From Ritual Axis to Vertical Landscape – Expanding the Understanding of Spatial Cosmology Buddhist temple area (Mendut temple-Pawon temple-Borobudur temple)



	Mendut	Pawon	Borobudur
Temple Cosmology	 <p>Mendut Temple is oriented 33° west (237° azimuth), facing northwest and serving as the entrance, then facing southeast. Its uniqueness lies in its slope, which is not aligned with the east (90°), but shifted westward, likely for cosmological or topographical reasons. In the Vesak ceremony, Mendut serves as the starting point, symbolizing understanding.</p>	 <p>The main axis of Pawon Temple runs from northwest to southeast at 20° from the west (250° azimuth), so that the entrance is located on the northwest side, while the main viewing direction is to the southeast. In its cosmological concept, Pawon serves as a balancing point (a place of purification) that connects Mendut Temple, which symbolizes understanding, with Borobudur Temple, which represents enlightenment towards Nirvana.</p>	 <p>Borobudur Temple faces east (90° azimuth) with the main entrance on the east side. The ascending pattern follows a spiral path from the east to the central stupa at the top, leading westward, in line with the symbolism of spiritual enlightenment (the endpoint) often associated with sunrise. Settlements around the temple, such as the hamlets of Tuksono and Karanganyar, developed along the main road and their location relative to the temple site.</p>
Settlement Morphology			

<p>Result</p>	<p>Spatial analysis indicates that Mendut Temple is oriented 33° west (237° azimuth), with the entrance from the northwest side toward the southeast. This orientation deviates from the cardinal east (90°) and appears to follow a more specific orientation, both topographically and cosmologically.</p> <p>A settlement map around Mendut Temple shows that some traditional settlement paths and the orientation of old houses conform to the road and possibly the temple's orientation axis. Settlements tend to follow the contours and road alignment, but the main orientation of traditional houses is parallel or nearly parallel to the temple's axis.</p>	<p>Based on spatial analysis, Pawon Temple is oriented 20° west (250° azimuth), with the entrance facing northwest and the primary viewpoint to the southeast. This position demonstrates a diagonal orientation to the cardinal points, with the temple's axis tilted approximately 70° to the east-west axis.</p> <p>The settlements around Pawon Temple, particularly along the traditional route connecting Mendut and Borobudur Temples, exhibit a linear pattern that follows the direction of the road and does not align completely with the temple's orientation axis. Some older houses appear to have adapted their position to the road, rather than directly facing the temple.</p>	<p>Borobudur Temple is primarily oriented westward, with the main staircase and ritual entrance on the east side. The ascending spiral pattern of the stupa mandala directs the journey westward and ultimately to the top of the stupa, symbolizing the attainment of enlightenment. This orientation differs most from the two previous temples because it is understood as the endpoint of the journey (sunset). Settlements around Borobudur developed in two main phases: Traditional settlements (such as Tuksongo Hamlet) demonstrate a spatial connection to the temple's orientation and the river's flow. Modern settlements (post-1970–1980) tend to develop along the main roads and tourism networks, disregarding the temple's symbolic orientation. However, there are unique features in several locations, such as along Wanurejo Street, where the houses are oriented in a non-aligned direction, following the road that runs southeast-northwest.</p>
<p>Discussion</p>	<p>The Mendut Temple's orientation, which deviates from the cardinal directions, suggests a cosmological or symbolic intention, possibly rooted in Mahayana Buddhist spatial conceptions, which place the east as the direction of enlightenment and rebirth. However, the 33° tilt from the west suggests that the temple's orientation went beyond simply following the cardinal directions, but also took into account contextual factors, such as the position of the sun at a given time, the landscape, or the axis between other temples (Mendut–Pawon–Borobudur). The interconnected orientation of the temple and the surrounding settlements suggests that cosmology was not only embodied in religious buildings but also influenced the spatial structure of settlements. This</p>	<p>1. Southeast as an Open Spiritual Space The northwest-southeast orientation of Pawon Temple allows for a visual and symbolic connection with the east-south horizon. In some Nusantara and Javanese-Buddhist cosmologies, the southeast direction can be associated with the projection of a spiritual journey or transition between dimensions. This means that Pawon Temple can be interpreted as a liminal space that leads pilgrims from the profane world (Mendut) to the sacred world (Borobudur). 2. Adaptation to Topography and Procession Routes This diagonal orientation may also be adapted to terrain conditions and spatial relationships with other temples. Although not aligned with the orientation of Borobudur or Mendut,</p>	<p>1. East Orientation: Symbol of Enlightenment Facing east aligns Borobudur with Buddhist tradition, where the east symbolizes beginnings, birth, and enlightenment. This orientation also allows the morning sun to dramatically illuminate the reliefs and structures, enhancing the spiritual and visual experience. The spiral pattern rising from the east to the top of the stupa is not simply a direction of circulation, but also a narrative of spiritual transformation, from the mundane world to transcendent reality. Thus, Borobudur's orientation is not merely functional but also rich in symbolic meaning. 2. Settlements: From Sacred to Economic Space Early settlements tended to be within Borobudur's spiritual orbit, aligning living spaces with the temple's meaningful structures. However, in recent decades, spatial development has shifted. Main roads and the</p>

<p>supports the theory that traditional societies viewed space as a sacred entity that must align with religious symbolism. However, modern settlement developments have begun to deviate from this orientation, following the direction of roads, utility networks, and economic considerations. This signals a shift in spatial values from cosmological to pragmatic, an early indicator of a social shift in landscape structure.</p>	<p>Pawon still serves as the pivot point for the Vesak procession. This means that its symbolic function is more important than uniformity of direction.</p> <p>3. Settlements and Route Structure</p> <p>Settlements around Pawon follow the traditional function of roads as connections between temples. Thus, the orientation of the houses responds more to the direction of circulation and social connectivity than to the sacred orientation of the temple itself. This reflects a form of compromise between spiritual meaning and the socio-functional needs of society.</p>	<p>development of tourism infrastructure have established a new, pragmatic, and economic axis.</p> <p>New houses and facilities now face the road, rather than the temple. This signifies a shift in orientation from sacred to functional, part of a social shift in the cultural heritage landscape.</p>
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Table 1 shows that the shift in orientation from the sacred to the pragmatic has gradually shifted due to the weakening of the cultural landscape's 'gene' (weakening of emotional attachment to culture), where invisible rituals and tangible spatial harmonies are increasingly replaced by functional and economic logic. An analysis of the orientation of Mendut, Pawon, and Borobudur reveals that they form a spiritual corridor, initially emphasizing cosmological continuity in the understanding of Buddhist life, which is reinforced through the Vesak ritual. However, the dynamics of tourism and economic development show significant transformations in the surrounding settlement patterns. In this area, modern development tends to follow the road network and economic functions. This change indicates that the sacred axis that once shaped spatial identity has now been replaced by a pragmatic orientation rooted in tourism and accessibility. In line with Nas (2002), urban space and settlements in Indonesia must be understood as a dynamic process that is constantly negotiated between traditional symbolism and contemporary demands. Thus, the transition recorded in Table 1 is not only spatial but also reflects a social shift from sacred cosmology to modern economic logic, where settlement morphology and house typology tend to be functional, no longer following the previously existing philosophy.

Table 2. Comparative Results: Orientation and Structure of the Mendut, Pawon, and Borobudur Temple Settlement

Aspect	Mendut Temple	Pawon Temple	Borobudur Temple
Orientation	Northwest-southeast	Northwest-southeast	East-spiral-west
Azimuth	237°	250°	90°
Cosmology	Understanding (starting point)	Self-purification (balance)	Enlightenment towards nirvana (the final point)
Traditional settlement structures	Most follow the temple's axis (although some entrances and orientations vary). The street morphology is largely aligned with and perpendicular to the temple's axis. While the street grid pattern deviates from this, most residential slopes follow the temple's axis.	Has similarities with the settlements around the Mendut temple	Many residential building patterns still maintain a slope, often going against the direction of the road. However, buildings that no longer follow this slope are also more numerous than those in the Mendut and Pawon temple areas.
Modern developments	Centralized near-vehicle access	Commercial linear along the route between temples	Extending towards main roads and tourist destinations

Comparative Discussion: Symbolism of Unity, Diverse Orientations, and Social Dynamics

1. Symbolic Unity, Spatial Diversity

Although the three temples form a single ritual unit during Vesak (Mendut–Pawon–Borobudur), their orientations are not geometrically identical, but symbolically aligned. Mendut and Pawon temples orient from

northwest to southeast, while Borobudur orients from the east, a spiral ending westward, associated with birth, enlightenment, and spiritual awakening.

The differences in the orientation of the axes (237°, 250°, and 90°) indicate that the orientations of these temples are the result of a negotiation between cosmology and geographic/topographical context.

2. Settlements: From Sacred to Secular

Traditional settlements demonstrate spatial connectivity with temple orientation—houses and circulation routes tend to follow the direction of the temple or the axis between temples. However, this pattern is now beginning to be disrupted by the changing orientation of modern development.

For example:

- Borobudur has undergone massive expansion due to mass tourism, giving it a more commercial feel.
- Pawon has become a commercial corridor, but the villages still hold on to traditional values and beliefs.
- Mendut experiences orientation pressure from the road network, although some of its villages still follow the temple axis.

This change is an indicator of a social shift, where the spiritual and symbolic meaning of space shifts towards an orientation towards economics, accessibility, and infrastructure.

3. Orientation-Based Conservation Challenges

Differences in orientation and development of settlements pose challenges to preserving the cosmological meaning of the area. The discontinuity between past and modern spatial arrangements makes it difficult to experience a complete space in a ritual or spiritual context.

Therefore, conservation of temples and their surrounding landscapes is not simply a physical matter; it also requires consideration of direction, orientation, and spatial meaning as part of intangible heritage. This is based on the consideration that temple orientation is not only about direction, but also about spatial experience and spirituality, and that the spatial structure of traditional societies is a manifestation of long-standing cosmological structures.

Although Mendut, Pawon, and Borobudur temples historically and symbolically form a cosmological unity in the Vesak ritual, spatial studies show that the orientation of each temple and the growth patterns of surrounding settlements have undergone significant spatial differentiation, particularly in the modern context. These variations in orientation reflect adaptation to local terrain and symbolic functions, while also indicating shifting values in the structure of social space.

As an extension of this study, it is important to examine other temples in Central Java that are also shaped by cosmological structures, but within different topographical and cultural settings. In this context, Suku and Cetho temples, located on the slopes of Mount Lawu, offer contrasting perspectives on the orientation, meaning, and relationship between sacred architecture and traditional settlements.

Unlike Borobudur, which is situated in a valley landscape with a linear and horizontal orientation, Suku and Cetho stand in a vertical and symbolic landscape, making the mountain the central axis of spiritual orientation. In Javanese culture, mountains are believed to be the abode of gods and ancestors, so orientation towards the peak (north or northwest) has a deep sacred meaning.

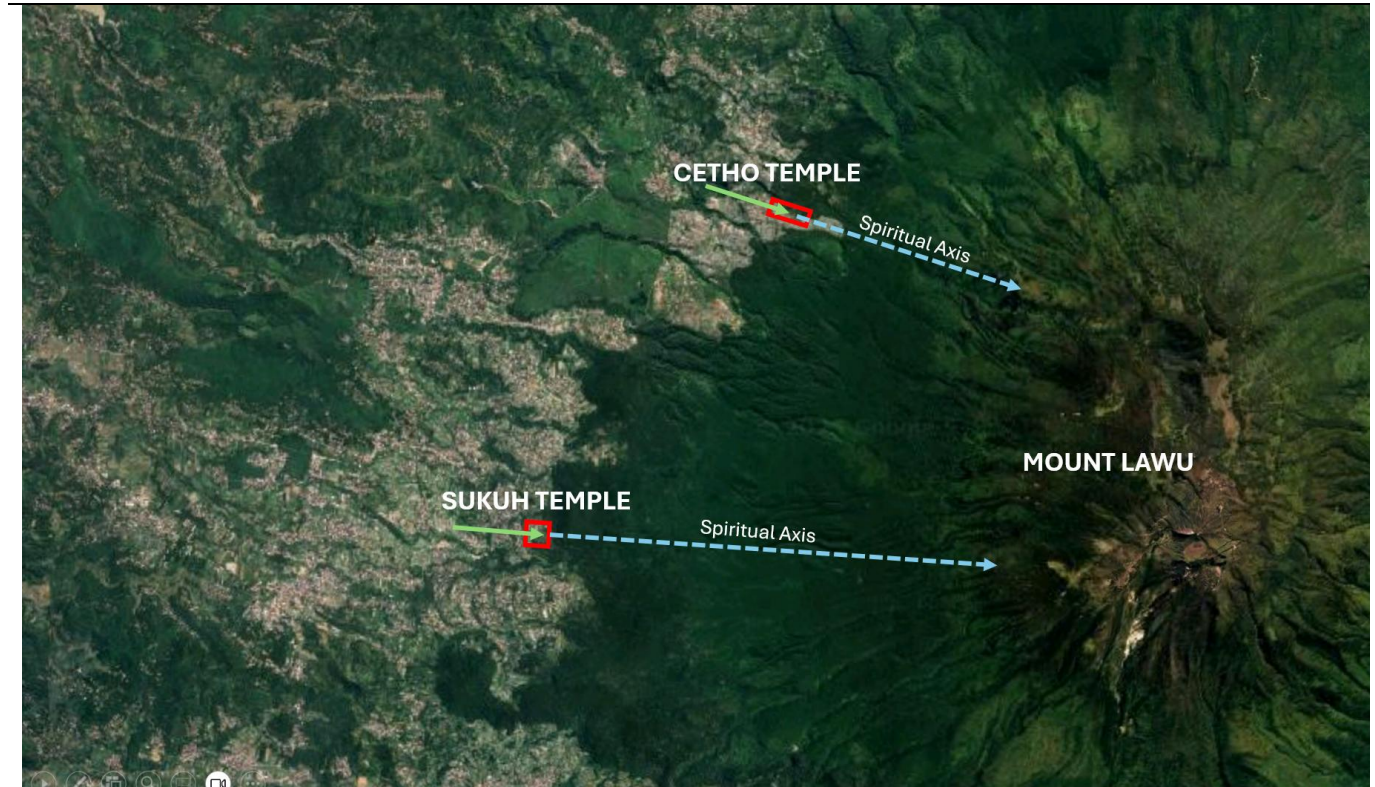
Table 3 shows the opposite of the results in Table 1, namely that the Cetho-Suku landscape exhibits a set of cultural 'genes'—a relatively intact landscape, where ritual practices, a mountain-oriented cosmology, and a linear settlement structure continue to reinforce each other, thus maintaining a strong living heritage identity. This is possible because the temples and settlements are located in mountainous areas, less impacted by mass tourism, and because the temples, beliefs, and rituals are still practiced by the local community to this day. In contrast to the Borobudur-Pawon-Mendut area, the orientation and morphology of settlements around Cetho and Suku still maintain a strong connection to the cosmological axis towards Mount Lawu. The linearity of settlements, the absence of dwellings on the main spiritual route, and the dominance of ritual practices indicate that sacred order remains a reference point in spatial structure. Geographical factors—such as the remoteness of the location and difficult accessibility—contribute to the preservation of this pattern, as does the strength of the Hindu-Javanese traditions still practiced by the local community. From Silverman's (2011) perspective, this situation demonstrates how cultural heritage is an arena of contestation that can result in erasure or marginalization; however, in the case of Lawu, limited external intervention actually allows local cosmologies to remain dominant in defining space. The more limited the scope of tourism, the more the temple's sacredness remains, along with its linear axis that influences local settlement patterns.

Comparative Discussion: Symbolism of Unity, Diverse Orientations, and Social Dynamics

1. Both were built in the 15th century, before the fall of the Majapahit Kingdom, intending to purify the country, which was in a state of chaos.
2. Although located in two different places, they share the same cosmology, only the level of spirituality is different (marked by the number of terrace floors; Suku Temple has 3 terraces, Cetho Temple has 11 terraces). Suku Temple still retains worldly characteristics, while Cetho Temple represents a release from the world to attain eternal purity (moksha, or liberation to nirvana).

3. The temple's orientation is not individual, but rather the same, centered toward Mount Lawu. This indicates syncretism, meaning the Hindu temples here have been influenced by Javanese beliefs (no longer as pure as the Hinduism of their country of origin, India).
4. There are social dynamics, as the settlement remains rural and the local community maintains strong Hindu-Javanese customs and culture. Tourist arrivals are limited due to the challenging access road (with many steep climbs and descents), as well as the strong sacred atmosphere and numerous myths that circulate, which can compel visitors to be respectful.

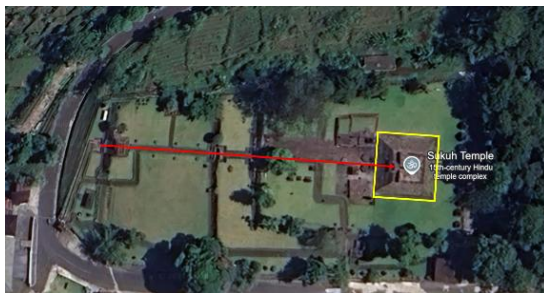
Table 3. STUDY TRANSITION: From Ritual Axis to Vertical Landscape – A Study of Understanding Spatial Cosmology (Hindu temple area - Cetho temple and Suku temple)



Suku Temple

Cetho Temple

Temple cosmology



Built in the 15th century, it has three terraces leading up to the main temple. The temple's azimuth is 110°-115° to the southeast, or towards Mount Lawu. In Hindu-Javanese cosmology, Mount Lawu is considered a sacred mountain where the gods, ancestral spirits, and the spiritual world reside. This orientation demonstrates that the beliefs of Javanese Hindus are not the same as their original teachings (India), which were always oriented west-east, but rather embrace local elements influenced by the contours and nature (in addition to beliefs related to Nirvana). Spiritually, Suku Temple depicts fertility rituals (but not eroticism), which are considered sacred and important because they are related to regeneration.



Like Suku Temple, Cetho Temple was also built in the 15th century and adheres to syncretism (a fusion of Hinduism and Javanese). Its azimuth is 125°-135° to the southeast (toward Mount Lawu). Unlike Suku Temple, Cetho Temple has 11 terraces. The higher you climb, the closer you get to the sacred site, like a journey toward moksha (spiritual liberation). Numerous reliefs depict fertility, indicating that this temple was not only a place of prayer, but also a ritual of self-purification and spiritual awakening. (Fontein, 1990)



Settlement Morphology		
Result	<p>There is no specific set of rules for temple orientation. The only thing that governs their orientation is their relation to Mount Lawu. Temples are always built on a slope, in a position considered visible for construction, close to the summit of the sacred mountain (Mount Lawu in Javanese Hinduism). Hindu temples with this terraced structure are typically used for worship and represent a spiritual journey toward moksha (eternity). Spiritually, during worship, the mind and soul are centered toward the summit of the sacred mountain.</p> <p>Due to the temple's importance and hierarchy, settlement patterns are linear, following the temple's direction. Settlements are also located on the west and south sides of the temple, with none on the east side.</p>	<p>Similar to Suku Temple, Cetho Temple has 11 terraces, indicating that, as a place of worship, the strata of Cetho Temple are higher than those of Suku Temple. The linearity of this area is also stronger, indicating that the pattern of rural settlement here follows the direction of religious/belief ritual processions, with the peak of the hierarchy of the journey to the temple, and upon entering the temple area and the temple core, the spiritual journey to the sacred mountain begins.</p>
Discussion	<p>Although Suku and Cetho temples are located in two different locations, both use Mount Lawu as the central point, which serves as a reference for the temple's orientation (as a place of worship). Both the temple and Mount Lawu are considered the most sacred places, so the spiritual axis created is not 'disturbed' by the presence of settlements, to maintain the sacredness of Mount Lawu's peak. The settlement here remains purely rural because the temple is located on the mountainside and follows a linear road pattern, which is influenced by the existence of religious ritual routes and beliefs.</p>	

Table 4. Comparative Results: Orientation and Structure of the Suku Temple and Cetho Temple Settlement

Aspect	Suku Temple	Cetho Temple
Orientation	Mount Lawu	Mount Lawu
Azimuth	110°-115°	125°-135°
Cosmology	Fertility rituals as sacred matters related to regeneration	Fertility rituals concerning self-purification, release from the world, and attaining holiness (moksha)
Traditional settlement structures	Linear, following the contours and patterns of the roads connected by rituals to the temple. There are no settlements in the spiritual axis area.	
Modern developments	It is an ancient rural settlement, which has not changed much over time, with the local people still holding on to their Hindu-Javanese culture and beliefs.	

Tables 1 and 3 present findings that can be further understood through the cultural-landscape gene framework presented by Li et al. (2023), which emphasizes the dual linkage of intangible cultural practices, such as rituals, beliefs, and symbolic building orientations, with landscape expressions, including settlement layout and environmental order.

In the case of the Borobudur–Pawon–Mendut axis (Table 1), the results indicate a weakening integration of cultural and landscape genes. While ritual practices such as the Vesak procession continue to embody a cosmological orientation, the morphology of surrounding settlements increasingly follows pragmatic considerations of accessibility, tourism, and economic growth. This condition represents a gradual erosion of the cultural-landscape DNA that once closely linked sacred rituals to spatial form. (Before 1983, several villages were part of the temple landscape and integrated into the temple's daily life.)

In contrast, the Cetho–Suku landscape (Table 3) exhibits a relatively intact set of cultural-landscape genes. Here, ritual practices rooted in Javanese-Hindu cosmology, an orientation toward Mount Lawu as the axis mundi, and a linear rural settlement structure remain closely intertwined. The persistence of these cultural and spatial features reflects a stronger continuity of living heritage identity, less disrupted by the pressures of urbanization and tourism. Village development here remains oriented toward an agricultural lifestyle, along with all its associated beliefs and culture.

Thus, the use of Li *et al.*'s (2023) theory clarifies how different temple-settlement contexts in Central Java demonstrate distinct cultural-landscape gene trajectories: one fragmented under modern socio-economic pressures, the other maintaining resilience through strong ritual continuity and a rural landscape that remains unchanged over long periods.

Recommendation

The findings of this study indicate that the orientation of temples in Central Java, both along the Mendut-Pawon-Borobudur axis (horizontal structure) and the Sukuh-Cetho temple axis (vertical structure), represents a cosmological and spiritual order rooted in intergenerational spatial experiences. However, urbanization and tourism development processes that fail to consider these orientations have disrupted the continuity of meaning within heritage landscapes. Preservation is crucial for maintaining the dynamic relationship between past, present, and future.

Several recommendations for achieving spatial harmony between sacred orientation and modern settlements (sustainability of meaning continuity) are as follows:

1. Contextual Zoning Based on Sacred Orientation

Zoning is formed based on the symbolic orientation of the temple as a reference, including:

- Establishment of visual and spiritual corridors from temples to sacred geomorphic elements (e.g., Borobudur as the center of the Mandala (universe); Cetho to Mount Lawu).
- Sacred visual axis buffer zone that maintains the hierarchy of the sacral axis from visual or structural disturbances.

(Case studies: Visual Management Zones-World Heritage Site (WHS) Angkor Wat, WHS Kyoto)

2. Regulation of New Building Orientation in Buffer Zones

New settlements should be arranged so that they follow or do not turn their backs on the orientation axis of the temple, and do not form patterns that obscure the legibility of the sacred spatial meaning.

3. Reactivation of the Processional Path and Traces of Meaning

Because this orientation pattern was once associated with ritual processions, the routes between the temples (Mendut-Pawon-Borobudur) and the Sukuh-Cetho temples to Mount Lawu should be designated as heritage trails, preserved spatially, visually, and symbolically. However, care must be taken to encourage participation rather than marginalize the community. This also provides an opportunity to strengthen regional identity and engage with meaningful tourism experiences, with the full support of the local community.

4. Spatial Planning Guide

Integrating azimuth-orientation into regional spatial planning, with the support of spatial analysis (GIS) and community participation.

5. Integration of Cosmological Perspectives in Environmental Impact Assessment (AMDAL) and Regional Spatial Planning (RDTR)

In every tourism project or infrastructure development in the buffer zone or cultural heritage area, it is necessary to conduct a routine feasibility evaluation, which should (must) include the aspect of "spiritual-cosmological spatial integrity" as practiced in the WHS in Bhutan and Japan, including ensuring that there is no disturbance to the axis mundi or orientation axis, which has sacred value.

6. Elaboration is needed, as expressed in the UNESCO "architecture of continuity" - living heritage framework, including:

- **Inheritance as a Dynamic Process:** The idea of continuity emphasizes that cultural heritage is not static, but rather a process that is constantly changing. Therefore, cultural heritage should be understood as an entity that is constantly transforming, not as a fixed form that must be frozen in its original state.
- **Community Involvement:** The principle of continuity emphasizes the importance of active community involvement in efforts to preserve and utilize cultural heritage. Local communities are positioned as key actors with a central role in preserving and maintaining their heritage, so the preservation approach must be collaborative, not simply top-down, driven by external parties.
- **Past, Present, and Future Relationships:** Cultural heritage is seen as a bridge across time, bridging the past, present, and future. It not only preserves inherited values and identities but can also serve as a source of inspiration and strength in designing sustainable development directions.
- **Sustainable Utilization:** It is crucial to ensure that cultural heritage is used sustainably, so that its benefits continue to be enjoyed by present and future generations without compromising its value or existence. This requires an integrated approach that balances preservation with social, economic, and environmental needs.
- **Regeneration to Maintain Relevance:** The concept of continuity also demands efforts to regenerate cultural heritage, ensuring it retains its meaning and function amidst the dynamics of the times. This regeneration can be achieved through education, the transfer of knowledge and skills, and creative adaptation to social and cultural changes. (UNESCO, n.d.)

CONCLUSION

Based on the studies conducted, it can be concluded that there are fundamental differences in settlement patterns between Buddhist temple areas and Hindu temple areas, particularly in their correlation with temple orientation. These findings of cosmological orientation and spatial shift patterns offer an important basis for heritage-based spatial planning. Integrating symbolic and sacred dimensions into zoning policies and settlement planning is key to maintaining the continuity of meaning and spatial experience in living heritage landscapes, such as the Borobudur and Cetho-Sukuh areas.

A comparison of Buddhist temples (and their settlement morphology) is as follows:

1. In the Buddhist temple complexes of Mendut, Pawon, and Borobudur, the building orientations are not uniform, although all three are understood as a unified whole in the Vesak ritual procession. Mendut, as the starting point for the procession, faces a shifting direction from the east. Pawon serves as a transition point with a diagonal orientation, while Borobudur faces east in a spiral pattern toward the top of the stupa, symbolizing enlightenment. These differences in orientation indicate that the orientations of Buddhist temples are determined more by their symbolic and philosophical functions, while also adapting to the surrounding topography. In terms of settlements, the Buddhist temple complex exhibits a spatial pattern that tends toward a grid and is developing in a rural-urban direction. The orientation of houses and the road network around the temples is not always related to the temple's sacred orientation, but rather follows pragmatic needs such as accessibility and transportation networks. Modern growth, particularly around Borobudur, is heavily influenced by tourism, so development pressures often overlook philosophical and cosmological values.
2. In the Hindu-Javanese temple complexes of Sukuh and Cetho, the building orientations are much more consistent. Both temples, located on the slopes of Mount Lawu, are oriented toward the mountain, believed to be the spiritual center. While there are variations in azimuth angle due to their respective positions, the cosmological principle remains the same: orientation toward the mountain peak as the sacred axis of the journey toward moksha. Meanwhile, the settlements around Sukuh and Cetho exhibit a linear pattern that follows the ritual path to the temples. Houses and roads are oriented in line with the direction of the procession toward Mount Lawu, while ensuring that no settlements occupy the spiritual axis between the temples and the mountain. Settlements in this area remain rural and relatively static, due to their location on mountain slopes that are difficult to reach by urbanization, thus preserving their traditional patterns and sacred orientations to this day.

The main findings of this study confirm a significant social shift, where the symbolic, cosmologically driven spatial logic of temples is increasingly losing its influence within the pragmatic, function-oriented morphological patterns of modern settlements. The alignment of sacred structures with astronomical phenomena represents legitimacy and cosmic order, but changes in their interpretation over time reflect societal negotiations over their identity, authority, and landscape.

Cultural heritage should not simply be seen as a static relic of the past, but as something living and evolving, involving active community participation in its preservation and utilization for future generations.

With its multidisciplinary approach, this study offers a new framework for understanding the cultural logic behind ancient spatial planning in Java. It opens up opportunities for further research into how cosmic symbolism continues to shape collective memory and contemporary heritage preservation practices.

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In this study, AI was used only for grammar, using Grammarly. The author confirms and declares that this article is based solely on his own original research.

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