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Pilgrimage Places and Sacred Geometries

Robert Stoddard
University of Nebraska - Lincoln, rstoddard1@unl.edu

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Pilgrimage flows, often involving millions of people, attract the attention of scholars seeking to explain these patterns of movement. A multitude of explanations have been attempted, but none has provided an entirely satisfactory understanding about why certain sites attract worshippers to undertake the sacrifices of pilgrimage. It is recognized that, from the perspective of many religious traditions, Earth space is not homogeneous — that specific places are sacred and different from the surrounding profane land. The reasons certain locations are holy and attract pilgrims from afar have long evoked the geographic question: Why are pilgrimage places distributed as they are?

The potential answers discussed here focus on general principles of location — rather than on ideographic descriptions of particular pilgrimage places. Specifically, this paper reviews some of the previously proposed answers to the question, concentrates on one locational hypothesis as it applies to a setting in the Kathmandu Valley of Nepal, and considers the more recently suggested theory of self-organized criticality.

**Proposed Explanations for Distribution of Pilgrimage Places**

An early attempt to formulate a general locational principle for pilgrimage places was theorized by Stoddard (1966; 1968), who examined the distribution of Hindu holy sites in India. He hypothesized that a specified set of holy sites would be located in an arrangement that would minimize the aggregate travel distances to the sites from the dispersed Hindu population. After generating several theoretical distributions, based on different sets of major pilgrimage places and varying definitions of the potential pilgrim population, he compared the resulting patterns with that of the actual sites. None of the theoretical distributions matched the actual one — thus indicating a less than optimal arrangement of pilgrimage destinations; but several matched better than a random pattern of points would predict.

Later the anthropologist Victor Turner (1973) suggested that pilgrimage sites occur at locations around the periphery of the pilgrim population. He did not formally test his hypothesis, but he cited a few examples to substantiate it. However, Sopher, after testing Turner’s contention...
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in India, found only 38 per cent of the pilgrimage places in peripheral locations (paper presented in 1981 and published posthumously in 1997: 185). Cohen (1992) also rejected the contention that pilgrimage sites tend to be in peripheral locations because of pilgrims' attachment to the socio-cultural core of their society.

Nolan and Nolan (1989) examined the same Turnerian thesis in their study of more than three thousand Catholic shrines in continental Western Europe. They compared centrally located ones (i.e. those situated in the urban area of cities with 25,000 or more persons) with remote shrines (those more than 50 km from a city and 10 km from any settlement). They noted that “34 per cent of the central shrines draw large numbers of pilgrims from extensive catchment basins, as compared to 16 per cent of the remote shrines” (299). When this observation is added to previous doubts about peripheral locations, the Turnerian hypothesis must be rejected as a satisfactory answer about the distributions of pilgrimage places.

A slight variation to the core versus periphery debate concerns a possible association of pilgrimage sites with major cities. In his 1966 study, Stoddard tested the geometric relationships between the 45 major pilgrimage sites in India with the 45 largest cities. He concluded that the generalized arrangements of the two distributions did not match well. Nolan and Nolan (1989) examined this same issue by noting the spatial proximity of many European shrines to settlement sizes. They observed that “about 18 per cent of the shrines are located in or near cities of 25,000 or more” (294), a proportion giving only limited support for associating pilgrimage places with urban centres.

Other attempts to establish locational relationships with pilgrimage places have commenced by observing their site features. According to Nolan and Nolan (1989: 303), “between 33 and 42 per cent of Europe's current shrines are associated with environmental features.” Similarly, Bhardwaj, in his intensive study of Hindu places of pilgrimage, states (1973: 95): “Our study shows a fairly strong association of Hindu sacred places with certain elements of the physical landscape, namely, flowing water and hilltops . . .” But as Sopher replies (1997: 184): “[These physical features] do not tell us which places associate with water and which particular hills will acquire special sanctity.” Certainly a topographic map alone will not produce a good predictor of pilgrimage sites.

In an attempt to generalize locational relationships for all religions throughout the world, Stoddard (1994) looked for areal associations with the 33 major pilgrimage places. He was able to conclude that “major pilgrimage places are located in areas of low altitude and moderate climate, where large rural populations have low incomes” (34). However, he utilized rather weak measures of association at a broad areal scale, so his results are not sufficient for predicting precise distributions of pilgrimage places.

Although these attempts to understand the locations of pilgrimage places have provided
some tentative answers, no encompassing principle of location has been accepted and the search for alternative hypotheses continues.

**The Role of Sacred Geometry**

It is well known that the arrangement of many sacred places reflects the geometry of a cosmogram, such as the mandala. For many societies throughout history, the mandala or yantra has been regarded as a graphic representation — or map — of the cosmos. This geometric projection of the universe consists of a pattern that surrounds and shapes the lives of inhabitants. By representing characteristics of the universe, the diagram structures religious activities, including movements to specific places.

Certainly in South Asia, Hindu and Buddhist cosmological ideas have influenced the arrangement of the built environment and associated activities for centuries. These range in scale from the arrangement of rooms to the layout of towns (Dutt 1925; Malville 1998). In Nepal, for example, visual evidence of the mandala as a pervasive model in the design of the built environment is common, especially in Newar settlements. At the scale of an individual house, its siting, orientation and relative proportions are based on the same geometric principles as expressed in a mandala (Vogt 1977).

At a different scale, the arrangement of buildings within and around a Nepalese town may also manifest a mandala (Gutschow and Kolver 1975; Pieper 1973; MacFadyen and Vogt 1977). At yet another scale, the importance of sacred geometries is clear in the discussion by Gutschow and Bajracharya (1977: 4) about sets of Matrika shrines that encircle inhabitants' sacred space:

In the case of Kathmandu, the first of these circles . . . surrounds the city, the second encompasses the valley and the third at times transcends the boundaries of the valley proper to include places traditionally under the spiritual . . . domination of Newar kings.

The next section of this paper, therefore, concentrates on the spatial arrangement of pilgrimage places in the well-defined region of the Kathmandu Valley of Nepal.

**Evaluating the Cosmological Model in the Kathmandu Valley**

The setting in which data were collected is the Kathmandu Valley. The Valley, which is almost circular, with a diameter of approximately 25 km, is a fairly discreet region because of the surrounding mountains. The location of several temples within this region may be best understood when they are considered as members of a set, with each position corresponding to a part of a Valley-sized mandala.
The study was guided by three questions:

1. Are there sacred sites within the Valley that are members of an intentional set? That is, do several places constitute parts of an overall unit of sacred space?

2. Are the sacred sites actually located in a geometric pattern? That is, does each place in a set have spatial significance in terms of an overall religious design?

3. Do most persons living in the Valley actually perceive specific sacred places as parts of a set? That is, do residents of the Valley perceive an enveloping cosmogram that determines the arrangement of pilgrimage places?

If persons intentionally make pilgrimages to replicate or to reaffirm the sacred geometry of the mandala, their actions will affect which shrines are considered to be important pilgrimage places today. This, in turn, will lend support to the contention that the distributions of at least some pilgrimage places in the world result from particular sacred geometries.

To answer the first two questions, this author consulted several experts and relevant publications. The experts were local persons who have studied the ancient religious texts and have specialized in understanding Hindu-Buddhist Tantricism. The publications were ones readily available in Kathmandu and written in English.

According to these sources, the answer to the first question seems clearly to be that, indeed, several religious sites do exist as sets. The experts and various publications generally agreed with what has been summarized in the monumental inventory of cultural features in the Valley, namely, the Protective Inventory (Prusha 1975). The Inventory lists several religious sets, including those of the Chara Ganesha and the Chara Narayana.

The answer to the second question about whether the sets of four sites form a meaningful pattern is not a clear-cut "yes." The lack of an unequivocal affirmation is partly because there is not complete agreement about which Ganesha and Narayana shrines are members of each set. The Ganesha shrines and their locations according to one page in the Protective Inventory are Surya Vinayaka (south of Bhaktapura), Jala Vinayaka (at the Chobar gorge), Rakta or Chandra Vinayaka, and Karya Vinayaka (fig. 10.1). However, elsewhere in the same publication, Ashok Vinayaka in Kathmandu replaces Karya Vinayaka; and Auer and Gutschow (1974) list a Ganesha shrine in Sankhu instead of Rakta Vinayaka.

Likewise, the four Vishnu shrines are usually, but not always, given as Changu Narayana (south-west of Sankhu), Ichangu Narayana (near Halchok), Sekh Narayana (near Pharping) and Bisankhu Narayana (midway between Lubhu and Godavari). As exceptions, Pandey and Prusha state that Buddha Nilakantha is even more important than these other four Vishnu temples; and Auer and Gutschow (1974) include a sixth one at Macchegaon.
With this diversity in enumerating which places actually constitute the set, it becomes a little difficult to discern whether either set does form a regular pattern that conforms to a Valley-sized *mandala*. Generally, the experts who commented on the geography of religious sites agree with the Gutschow thesis: sets of sites are theoretically positioned in the Valley in the cardinal directions. Nevertheless, the writers recognize that topographic features and ancient religious structures have modified a perfect north-south and east-west orientation, and these locational deviations from the ideal make it difficult to determine visually which of the conflicting
sites are most likely members of the set. This is especially true in the case of the Ganesha shrines because there was less agreement about which four of five major Ganesha shrines constitute the true set and their locations deviate from a square. In contrast, there was greater unanimity about the four Narayana temples. When Buddha Nilakantha and Macchegaon are omitted, the remaining four do display a certain spatial regularity with the Valley.

**Perceptions of Sacred Sites in the Kathmandu Valley**

The third question deals with how inhabitants perceive the geography of sacred sites in the Valley. Information about perceptions was acquired by asking selected villagers and townspeople about the major Ganesha and Narayana shrines. Fieldwork consisted of going to 25 sites scattered throughout the Valley during a month's period to interview 114 laypersons. A heterogeneous sample of persons was contacted, with the respondents representing a variety of ages (Table 10.1), schooling levels (Table 10.2) and occupations (Table 10.3). Respondents were asked to name the four main Ganesha shrines and then the four Narayana sites to describe the locations of all those sites and to show their locations on a large-scale map. Then they were asked why the sites are located as they are.

<table>
<thead>
<tr>
<th>Age group</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 - 31</td>
<td>24</td>
</tr>
<tr>
<td>32 - 41</td>
<td>23</td>
</tr>
<tr>
<td>42 - 51</td>
<td>26</td>
</tr>
<tr>
<td>52 - 61</td>
<td>20</td>
</tr>
<tr>
<td>62 - 78</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>114</td>
</tr>
</tbody>
</table>

Table 10.1: Ages of respondents

<table>
<thead>
<tr>
<th>Schooling</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>36</td>
</tr>
<tr>
<td>Read &amp; Write</td>
<td>28</td>
</tr>
<tr>
<td>Elementary</td>
<td>22</td>
</tr>
<tr>
<td>SLC</td>
<td>12</td>
</tr>
<tr>
<td>College</td>
<td>14</td>
</tr>
<tr>
<td>Unknown</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>114</td>
</tr>
</tbody>
</table>

Table 10.2: Schooling levels of respondents
Pilgrimage Places and Sacred Geometries

Table 10.3: Occupations of respondents

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmers</td>
<td>30</td>
</tr>
<tr>
<td>Shopkeepers</td>
<td>25</td>
</tr>
<tr>
<td>Teachers</td>
<td>19</td>
</tr>
<tr>
<td>Government &amp; Military personnel</td>
<td>11</td>
</tr>
<tr>
<td>Retired &amp; non-farm wives</td>
<td>10</td>
</tr>
<tr>
<td>Misc./Others</td>
<td>19</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>114</td>
</tr>
</tbody>
</table>

Table 10.4: Frequency of Ganesha shrines named, mapped and visited by respondents

<table>
<thead>
<tr>
<th>Place</th>
<th>(a) Named</th>
<th>(b) Named and Mapped</th>
<th>(c) Named, Mapped and Visited</th>
<th>(d) Visited</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surya Vinayaka</td>
<td>92</td>
<td>74</td>
<td>49</td>
<td>54</td>
</tr>
<tr>
<td>Ashoka Vinayaka</td>
<td>85</td>
<td>74</td>
<td>50</td>
<td>60</td>
</tr>
<tr>
<td>Jala Vinayaka</td>
<td>71</td>
<td>55</td>
<td>21</td>
<td>30</td>
</tr>
<tr>
<td>Rakta Vinayaka</td>
<td>63</td>
<td>49</td>
<td>20</td>
<td>29</td>
</tr>
<tr>
<td>Karya Vinayaka</td>
<td>50</td>
<td>39</td>
<td>16</td>
<td>19</td>
</tr>
</tbody>
</table>

Table 10.5: Frequency of Narayana shrines named, mapped and visited by respondents

<table>
<thead>
<tr>
<th>Place</th>
<th>(a) Named</th>
<th>(b) Named and Mapped</th>
<th>(c) Named, Mapped and Visited</th>
<th>(d) Visited</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changu</td>
<td>97</td>
<td>75</td>
<td>21</td>
<td>28</td>
</tr>
<tr>
<td>Ichangu</td>
<td>85</td>
<td>60</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>Sekh</td>
<td>83</td>
<td>64</td>
<td>24</td>
<td>28</td>
</tr>
<tr>
<td>Bisankhu</td>
<td>83</td>
<td>57</td>
<td>11</td>
<td>16</td>
</tr>
<tr>
<td>Buddhnilakantha</td>
<td>27</td>
<td>15</td>
<td>11</td>
<td>19</td>
</tr>
<tr>
<td>Macchegaon</td>
<td>7</td>
<td>3</td>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>
The answer to the question about the perceived sacred geography of the Kathmandu Valley is based on their responses. First, the extent to which respondents identified sets of Ganesha shrines is noted in Table 10.4. From Column (a), it appears that the interviewed laypersons — like the experts — were uncertain about which of the five Ganesha shrines constitute the actual set of four. This uncertainty is evidenced by the gradual decrease from 92 to 50 in the frequency the top five places were named — rather than a sharp break after the mentioned top four.

In contrast, respondents were more certain about which of the four Narayana sites form a distinct set, as revealed by the fairly obvious break in frequencies between the fourth and fifth listed shrines (Table 10.5, column (a)).

It is possible that persons might perceive a spatial regularity in sacred places even though they might not give such an explanation verbally. In an attempt to detect whether respondents visualize a mandala-like pattern in the positions of Ganesha and Narayana shrines, the interviewed persons were asked to show the locations of these shrines by placing stones on a large cloth-map placed on the ground. This base-map included the Valley rim, along with a few of its demarcating peaks, all the main streams, the major surfaced roads and a few landmarks — but, of course, no shrines. The responses are summarized here by both a frequency table and a map. Column (b) of Table 10.4 shows the number of respondents who mapped, as well as named, each of the five main Ganesha sites. It is evident that a strong majority of those who identified specific shrines were willing to indicate where they thought the Ganesha sites are located.

All of the locations marked on the field map of the Valley by respondents have been transferred to the map shown at fig. 10.2. This technique does not display the locational perception of each individual, but it provides a clue to the collective concepts. The general impression conveyed by this map is not one of greater regularity than displayed by the actual sites. That is, if respondents truly envisioned the temples situated according to the regularities of the mandala then they might be expected to place stones on the map in a more regular arrangement than the true geographic positions. Instead, the dots seem to cluster around the actual sites, especially the best-known ones.

The same procedures were followed for the Narayana shrines. Column (b) of Table 10.5 again signifies that a large majority of those who named a particular Narayana shrine also indicated on the map their answers about its position in the Valley. Respondents’ perceptions about the locations of Narayana shrines are shown in fig. 10.3. The collective perceptions indicate some regularity but this could well be because the actual sites are, in fact, situated in a fairly regular pattern. Consequently, the results may reflect good mapping skills rather than a tendency to place the markers according to a perceived mandala pattern.
In reply to the question about why Ganesha and Narayana shrines are located as they are, only two persons pointed out that the sites are located in the four directions; two others regarded the shrines as protectors for the Valley; and three interviewees specified that the four shrines were situated to serve the entire Valley. Four persons declared that the position of Surya Vinayaka in the east is significant, but they did not mention the other three as having similar locational importance. Another thirteen told a specific story about why a particular location is sacred. Approximately 80 per cent of those who answered this question, though, did not provide any reason for the spatial distribution of sacred sites.
Admittedly, there may be some problems with these data. For one, respondents were not selected by a statistically random procedure. That is, no prescribed method for using a sampling frame was employed and thus the respondents cannot be regarded necessarily as an unbiased subset from the general Valley population. However, if there is any bias, it is probably that persons having more information about places away from their immediate vicinity were over-represented. For example, a higher percentage of school teachers were interviewed than their proportion of the total population (see Table 10.3), thus producing a sample of persons who undoubtedly leave their home-village more frequently than do farmers. It is reasonably safe to
assume that persons not chosen for interviewing were even less aware of religious places outside their immediate locality. Therefore, this possible source of error would not jeopardise a negative conclusion about perceptions of patterns in the locations of Valley sites.

Secondly, respondents may not have given correct information. It is recognized that, in any technique that depends on the co-operation of others, people may deliberately choose to mislead the interviewer. However, the percentage of persons in the Kathmandu Valley willing to answer questions compares very favourably with other parts of the world and indicates a positive attitude about giving valid answers.

Respondents may have given incorrect information unintentionally. This problem could arise from faulty communication. Under the best of conditions it is possible that an interviewer and interviewee misunderstand what the other person is trying to say. The possibility of such misunderstanding is increased if the information must be communicated through a third person, especially when the conversation must be translated into another language. Fortunately many of the questions and answers were fairly factual, so these data were probably communicated satisfactorily; but the attempt to learn about respondents' beliefs about regularity in religious sites undoubtedly was less successful.

Incorrect information could occur from memory lapses or similar mistakes. This situation is illustrated by those who were not able to remember names or places or to use the map. Some persons knew where a Ganesha or Narayana temple was located but could not remember its name. Others knew a name but forgot the location. And, of course, people vary in their ability to understand and communicate an isomorphic relationship between earth locations and map positions. Analysis of the data, however, does not suggest any major sources of limited knowledge. Columns (c) and (d) of Table 10.4 provide information about the level of mapped replies by those who visited each Ganesha shrine within the previous 12 months. The percentage of those who had visited the sites and also mapped them was high — not only for the frequently visited Surya Vinayaka and Ashoka Vinayaka shrines but for the other three also. Although the number of respondents who visited the Narayana shrines was generally lower than the Ganesha shrines (Table 10.5, columns (c) and (d)), the percentage of visitors who also mapped the shrine locations remained high.

The possibility that a correlation between responses and characteristics of the interviewees was checked by examining the locations of respondents, their gender, and their ages. No correlations were significant enough to alter the basic conclusion: Valley residents generally are not conscious of an enveloping cosmogram.

Although residents of the Valley may view the various shrines as belonging together in one of the two sets, very few respondents gave any reason for the locations of the shrines. In
contrast to the experts, who usually related the positions of the shrines to the cardinal directions in the Valley, the laypersons seldom mentioned any overall pattern. Many respondents did answer queries about local shrines around their own village or town in terms of protective positions, but they rarely applied the same kind of locational model to the sets of shrines in the entire Kathmandu Valley. Consequently, it seems safe to conclude that, although inhabitants regard spatial regularity as very important in the sacred space of their local vicinity, they do not necessarily perceive a similar geography of sacred sites at the scale of the Kathmandu Valley.

This absence of a perceptual sacred geometry, however, does not necessarily determine pilgrimage behavior. Most respondents did consider four specific shrines as belonging to a set (i.e. one set for Ganesha and one for Narayana), and each set was identified as distinct. Further evidence that the four Narayana shrines are regarded as members of a unique set was acquired when two dozen respondents reported that, during the last ten years, they had made the special circular pilgrimage to all four of these.

The lack of awareness about concepts held by religious leaders, however, does not necessarily negate a type of geometric regularity in their pilgrimage behavior. For example, each year at the time of Haribodhini Ekadashi, pilgrims make a one-day 40-km journey to the set of four Narayana shrines in the Kathmandu Valley. More than one in five respondents reported that, during the last ten years, they had made the special circular pilgrimage to all four Narayana shrines. Thus, even though many pilgrims may not be consciously aware of an encompassing sacred geometry, their aggregate pilgrimage flows perpetuate the importance of these regularly spaced pilgrimage-places.

These results suggest at least three avenues for additional inquiry. One concerns the areal scale of study. Although the spatial isomorphism between a conceptual sacred geometry and actual religious movements is fairly well understood within homes and temples, it is less apparent for an area the size of the Kathmandu Valley. This outcome leads to the need for extending the study geographically by looking at other regions where similar cosmological geometries are known to exist.

A second avenue opens the search to the entire Earth over long periods of time. Although much insight can be gained from restricting studies to short timespans and to small areas where variables are limited, broad patterns of behavior may be missed.

A third observation is that an inventory of reasons given by individual worshippers to a particular pilgrimage site does not necessarily reveal the patterns produced by a multitude of pilgrims. Plotting the paths of individual grains of sand may not detect the configuration of a large dune. Looking at major pilgrimage flows may yield insight not detected by examining the details of only a few sacred sites.
Consideration of Self-organized Criticality

The foundation for additional comments here consist of (1) observations about places on the Earth exerting perpetual sacred power combined with (2) the theory of self-organized criticality. Discussion about places of sacred power is provided by Gray (2007), who has visited and experienced, as well as interacted with worshipping pilgrims, at pilgrimage sites throughout the world. He states (2007: 9):

Over the long pageant of civilizations – endlessly rising, falling, and rising again – one phenomenon has remained constant in the background of continuing use of power places by one culture after another. Prehistoric and historic cultures keep coming and going, yet the power places have exerted a spiritual magnetism that transcends human time. The great religions of the historical era – Hinduism, Taoism, Buddhism, Judaism, Christianity, and Islam – have each taken over the sacred places of earlier cultures and made them their own.

According to this perspective, various sites across the Earth have attracted worshippers in prehistoric and historic eras because they experienced enlightenment, a healing of their bodies, a burst of creativity, and similar life-changing transformations. This is not to deny that particular religions may attribute a specific meaning to selected sites; but concurrently it declares that certain places are inherently prone to attract humans with spiritual aspirations. Sacred scriptures and religious leaders may promote worship at specific sites during long periods of time, but this does not deny the existence of universal power points. As stated by Malville, 1999: 10):

As self-organizing systems, the complexity of the pilgrimage landscape may be natural and internal, and we do not need to look for the evidence of structure imposed by decree or by a city planner, pundit, or priest when encountering complex geometries and complex ritual.

Furthermore, according to Gray, the sanctified power of places is amplified by the intensity of religious energy exerted by millions of worshippers over long periods of time. This intensification of sacred power creates a dynamic system that is both self-fulfilling and evolving. Pilgrimages may be generated by specific religious beliefs in events that occurred and/or continue to occur at particular sites, but these places have attracted, and will continue to attract, pilgrims from other religious traditions at other times in history. It is this characteristic of a natural system – one not in equilibrium – that provides the basis for embracing the theory of Self-organized Criticality.

The concepts of Self-organized Criticality are discussed more thoroughly elsewhere in this volume (Malville: Chapter 2); but some of the system’s characteristics are applicable here. One concerns the value of studying phenomena comprehensively. Bak and Chen state (1991: 46):
Self-organized criticality is a holistic theory: the global features, such as the relative number of large and small events, do not depend on microscopic mechanisms. Consequently, global features of the system cannot be understood by analyzing the parts separately.

A second characteristic is its dynamic nature. The “composite systems never reach equilibrium but instead evolve from one metastable state to the next” (Bak and Chen, 1991: 46). The ebb and flow of pilgrimages to certain places over eons of time, irrespective of particular religious beliefs about the uniqueness of a site for a period of time, inevitably substantiates a perspective of change among its constituents.

A companion factor relates to the incremental impact of pilgrims’ journeys on future pilgrimages. Whether it results from an increase in site energy, as proposed by Gray, or primarily from the effects of pilgrimages' popularity, the results may contribute to the critical state that is an important component of a system of Self-organized Criticality.

Although these similarities do not demonstrate the applicability of the concepts of Self-organized Criticality to understanding pilgrimages and the distribution of sacred sites, they certainly provide another insightful direction for further study.

Acknowledgement

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and Complexity International Seminar, New Delhi.