GEOSPATIAL TECHNIQUES FOR HERITAGE SITE MONITORING AND EVALUATION OF TOURISM POTENTIAL IN UTTARAKHAND

Sudha Ravindranath[1] ,Vidya A.[1], Parul Bukadia[2] and Uday Raj[3]
[1]Regional Remote Sensing Center-South, National Remote Sensing Centre, Marathahalli Outer Ring Road, Bengaluru- 560037
Email: ravisud4@gmail.com
[2]M.Sc. Remote Sensing and GIS,Kumaun University, Almora-263601
[3]Regional Centres, National Remote Sensing Centre, Hyderabad-500037

KEY WORDS: CARTOSAT-1, LISS-IV, Landuse/Landcover, weighted ranking method, monitoring

ABSTRACT: India is culturally rich country known for its cultural heritage through its nationally important archeological heritage sites and monuments. Monitoring of the heritage sites/monuments is essential as they face increasing risk due to unplanned urbanization, tourism, natural and man-made disasters, etc. In this study, geospatial techniques have been used for monitoring six national monuments / heritage sites (for eg. Kalinga monument in Dehradun, old cemetery in Roorkee) in Uttarakhand which are located in diverse geographic and economic conditions with different religious backgrounds. Multi-temporal high resolution satellite images viz., Landsat ETM+ (2000-2001), Cartosat-1 & LISS IV (2009-10) and other ancillary data have been used to monitor the development/expansion around the heritage sites within a specific buffer area encompassing its management zones viz., prohibited and regulated boundary. Landuse / Landcover (LU/LC) change analysis indicated changes in vegetation and built-up area categories, especially in the sites located within a city/town viz., Dehradun and Kashipur as compared to others located in remote areas, providing an important input for authorities for effective management. Evaluation of the tourism potential of these sites has been carried out to suggest planning strategies for overall area improvement including economic development. The tourism potential of the sites have been evaluated based on physical, social, and environmental parameters using weighted ranking method, a popular multi-criteria decision making tool. Based on the total tourist potential scores, the sites have been classified into four categories very high, high, medium and low potential and the planning strategies for improvement has been worked out. The methodology adopted in the study for monitoring can be extended to other nationally important monuments in Uttarakhand region for efficient management and conservation. The weighted ranking approach can be used to prepare a tourism developmental plan for improving the tourist inflows for other important heritage sites and monuments.

1 INTRODUCTION

Archaeological/heritage sites and monuments are often located in places which had value in the past and are still regarded as valuable.In Indian context, monuments are considered as architectural works, works of monumental sculpture and paints, elements or structure of archaeological nature, inscriptions, cave dwellings and combination of features which have outstanding heritage value from the point of view of history, art or science. Sites are defined as works of man or combined work of man and nature with outstanding value of history, aesthetics, ethnology or anthropology. The interrelationship among variety of cultural and natural parameters existing within the vicinity of the site determines the preservation, conservation and management practices of heritage. Monitoring of the heritage sites/monuments is essential as they face increasing risk due to unplanned urbanization, tourism, natural and man-made disasters, etc. In the recent years, Satellite remote sensing has become a common tool of investigation, prediction and forecast of environmental change and being a non-destructive technique, it can contribute to the investigation of an archaeological site too. Geospatial techniques are now being extensively used for monitoring and management of heritage sites world over and in Indian context also. National Remote Sensing Centre (NRSC) & Archeological Survey of India (ASI), in a joint collaborative project has carried out systematic inventory & generation of management zones for nearly 3600 nationally important monuments of the country and hosted the geospatial database on BHUVAN (web: bhuvan.nrsc.gov.in/governance/culture_monuments)

Maintenance of ancient monuments and archaeological sites & remains of national importance is the prime concern of the ASI, Ministry of Culture. It regulates all archaeological activities in the country as per the provisions of the Ancient Monuments and Archaeological Sites and Remains Act, 1958 & 2010. According to this act, three management zones have been defined viz., Protected boundary, Prohibited boundary and Regulated boundary. These three boundaries define site management zone for a particular monument/site which clearly specifies the rules & regulations, heritage bye-laws to be implemented etc. Monitoring of the heritage sites over period of time is an important requirement which can be met through use of geospatial techniques.(Sankhala,2014, Samanta, 2012, Noor,2015)

Another important concept associated with the heritage sites is its attraction to tourists. It is well known that, contribution of tourism can be significant to sustainable development and economical up-liftment of a region if planned methodically. Literature survey has revealed that tourism potential is an important concept which describes the tourist attractiveness of a place which can be a qualitative or a quantitative measure. To name a few studies, use of remote sensing and GIS to carry site suitability analysis for tourism development (Ibrahim Rizk Hegazya, 2015, Pareta, 2013); policies for protection of World Heritage Sites (Mario Hernandeza, 2008; Mukesh, 2009); Integrated planning for World Heritage town of Paphos in Cyprus (Hadjimitsis,2006) andWeb enabled tourist information system (Gupta, 2015). Corneliu, 2010, has considered Tourism potential as function of demand and supply interaction while Abdulla Al Mamun and Soumen Mitra, 2012, formulated a simple methodology to quantify tourism potential for a region from secondary sources, where detail data is not readily available. Other studies by Yuan, 2011 and Poonia, 2013 also describe methods for tourist potential evaluation.

In the present paper, role of remote sensing and GIS as a monitoring tool in analyzing land use/ land cover change patternas well as forevaluation of tourist potential in conjunction with ancillary information collected through secondary sources has been presented.

2 Objective of the study

The study aims to identify and compare changes in land use and land cover over time and space in and around the heritage sites & monuments. There are 42 nationally important heritage/archaeological sites under ASI in Uttarakhand which includes temples, fortress, excavated sites, rock inscription, caves and Cemetery. A systematic evaluation of all the 42 sites with respect to geographical setting, architectural structure/construction, culture, time period etc., has been carried out and six sites have been chosen for detailed study with the following objectives.

- Monitoring of six nationally important heritage sites of Uttarakhand using remote sensing and GIS technique over time and space.
- To examine the changes occurred within the management zones of the heritage sites or monuments over time and space.
- To examine the Tourism Potential of six nationally important heritage sites and suggest suitable measures to enhance the tourism potential.

3 Study Area and Data Used

ASI under the provisions of the AMASR Act, 1958, protects monuments, sites and remains of national importance. According to this act, three management zones have been defined: Protected boundary (monument boundary), Prohibited boundary (100m from protected boundary) and Regulated boundary (200m from prohibited boundary). As mentioned earlier, these three boundaries define site management zone for a particular monument/site. In this study remote sensing data has been used to study the change in landuse/landcover from the year 2000 to 2010 within 1 km buffer around the site. A brief description of the six nationally important heritage sites is given in Table 1. The site management plan along with the ground photograph is given in Figure 1.

Multi resolution temporal remote sensing satellite data along with ancillary information from secondary sources has been used to carry out the study. Landsat ETM+ data has been used for generation of Landuse /Landcover map of 2000& high resolution fused product of LISS-IV (5.8m) and Cartosat-1 (2.5m) for generation of Landuse / Landcover map of 2010.

Table 1:Description of six nationally important heritage sites of Uttarakhand

Site	Heritage site name	Location	Best time to visit	Natural attraction
Site 1	Kalinga monument	Dehradun	best time to visit Dehradun is throughout the year	Malsi deer park(10km), Sahastradhara (14km), Rajaji National park(25.7km)
Site 2	Ashoka rock edict	Kalsi	February-October	Asan Barrage(4.5km) Dakpathar(7km), Timli pass(10km)
Site 3	Lakhamandal temple	Chakrata	March-November	Chilmiri Neck (5km), Deoban (16km)Tiger fall(20km)

Site 4	Old cemetery	Roorkee	October-March	SolaniAqeduct(1.5km) Neel dharapakshivihar(30km), Harkipauri
Site 5	Mound (Site of Govisana Fort)	Kashipur	February-April and September-October	Dronasagar(0.5km), GiriSarovar (2km), Jim Corbett National park (29km)
Site 6	Three temples of Indo-AryaShikara type	Garur	October-May	Kausani (14km), Kausani tea estate(18km) Binsar(28km)

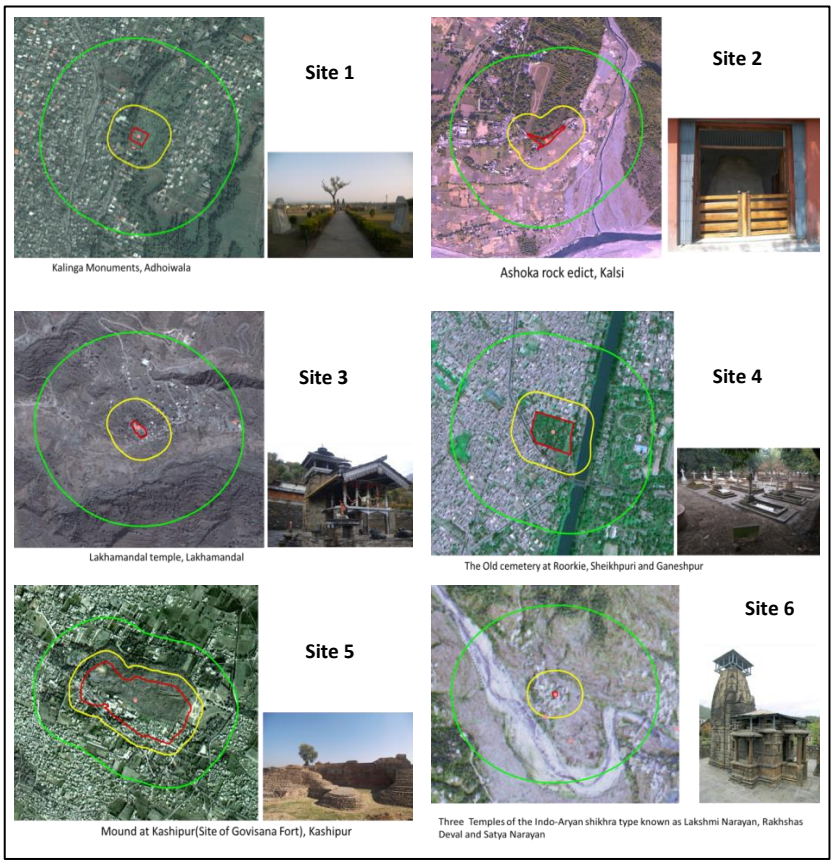

Figure 1:Six Nationally Important Heritage sites with respective site management plans

4 Methodology

The database includes generation of time series satellite data of two periods - Landsat ETM+ images of 2000 and Cartosat 1 and LISS-IV merged images of the year 2010. The satellite images have been used to generate landuse maps of the study area to study the changes happened around the monuments over the years. A brief methodology used in the study for monitoring and evaluation of tourist potential is shown in Figure 2a and Figure 2b. The natural and cultural attraction parameters have been considered while choosing the 6 sites.

4.1 Monitoring of Heritage sites

The methodology followed for monitoring of heritage sites over time and space is given above in Figure 2a. Satellite Image chips have been extracted for each site for an area of 1 km buffer from two data sets. Using visual interpretation techniques, landuse/landcover maps have been generated and also area statistics computed. Basically six major classes have been delineated viz., Monument and its extent, Built-up, Road network, Vegetation, Water Body, Open lands/Fallow land. Final landuse change analysis has been carried out and three types of changes have been identified, viz., no change, positive and negative change areas. Generally, change from fallow areas to vegetation is considered as positive whereas change into built up from vegetation or fallow land or water body is considered as negative. The areas where the landuse has not changed over time have been considered as no change. The landuse/landover maps have also provided inputs for computation of tourist potential evaluation. For e.g. if

there is more vegetation and less settlement around heritage site, it might indicate that there is less connectivity and accessibility which has a direct/or indirect impact on tourism.

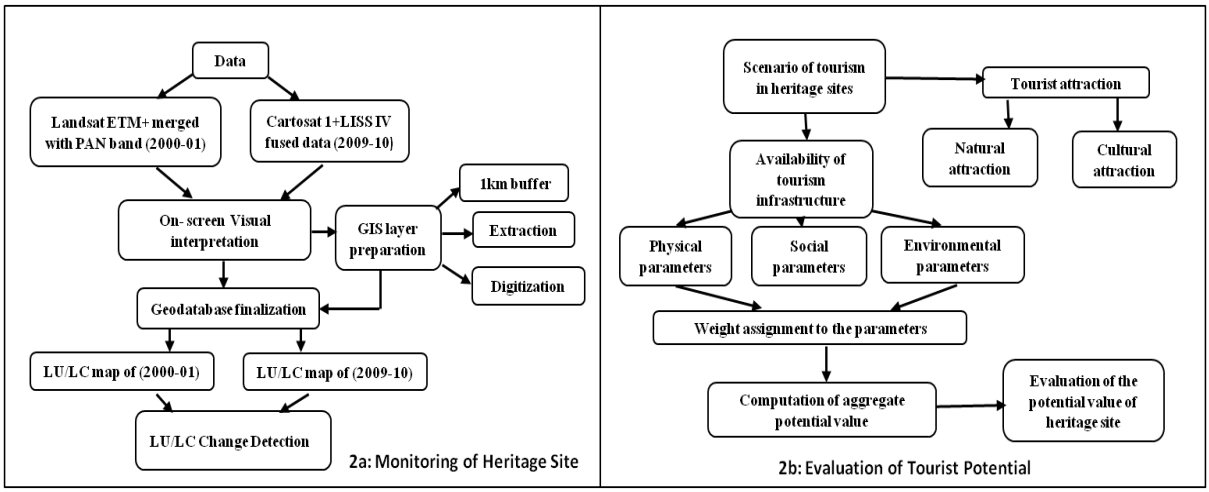

Figure 2a and 2b: Brief methodology used for monitoring of Heritage sites and Evaluation of Tourism Potential

4.2 Monitoring of Heritage sites

The methodology followed for monitoring of heritage sites over time and space is given above in Figure 2a. Satellite Image chips have been extracted for each site for an area of 1 km buffer from two data sets. Using visual interpretation techniques, landuse/landcover maps have been generated and also area statistics computed. Basically six major classes have been delineated viz., Monument and its extent, Built-up, Road network, Vegetation, Water Body, Open lands/Fallow land. Final landuse change analysis has been carried out and three types of changes have been identified, viz., no change, positive and negative change areas.Generally, change from fallow areas to vegetation is considered as positive whereas change into built up from vegetation or fallow land or water body is considered as negative. The areas which remained intact over time have been considered as no change. The landuse/landover maps have also provided inputs for computation of tourist potential evaluation. For e.g. if there is more vegetation and less settlement around heritage site, then it might indicate that there is less connectivity and accessibility which has a direct/or indirect impact on tourism.

4.3 Tourism Potential Evaluation

Tourism Potential Evaluation is a method of quantifying and qualifying the potential of tourist place/site in terms of scenic/aesthetic, scientific, cultural/historical, and social/economic values as shown in Figure 2b. In this study with the help of GIS analyst tools and other techniques, the tourist potential for 6 heritage sites have been evaluated. Composite index has been computed for the heritage sites to find out the level of availability of infrastructure for tourism. This has been done by selecting indicators/parameters and index has been calculated for the selected six heritage sites/monuments. Indicators/parameters have been finalized based on the literature survey as well as observation of the sites. A total of 11 parameters have been used in the study on the basis of physical, social and environmental aspects to evaluate the Tourism potential. Some of the parameters may not relate directly with tourist arrivals and their stay but they play a crucial role in tourism satisfaction enhancement. It was observed from the collected in formation that the Tourist arrival is at peak in the month of March to May or September to November.

4.3.1 Rank assignment to the parameters of three aspects:

As observed in many researches, potential of tourist arrival is dependent upon the quality of service, availability of tourism infrastructure and socio- cultural background of the tourist. Tourist has many options for choosing destination and this choice value can be enhanced by upgrading the quality of service and availability of tourism infrastructure. For analyzing tourist potential, first step is to assign rank (potential value) to all the eleven parameters of physical, social and environmental aspects used in the study. One to five ranks have been assigned to the parameters according to the importance of the facility for tourist and depends upon the availability of facility near heritage site. Highest rank (5^{th} rank) assigned to the site where more facilities are present near destination and lower rank (1^{st} rank) assigned to the site where the less facilities are present. The rank assignment based on physical parameters, social parameters and environmental parameters are given in Table 2a and 2b, Table 3 and Table 4 respectively.

4.3.2 Computation of aggregate Potential value

After assigning ranks to all the parameters, second step is to calculate the aggregate potential value. All the potential values will generally range from 1-5, where lower values indicate weakness as compared to strength. The aggregate value works as an indicator for tourism potential; however, it may not identify the intensity and strength in different aspects of heritage sites. Potential value of a heritage site is finally aggregated in an additive way. Aggregate potential value of physical, social and environmental aspects is the sum of potential value of all the parameters given in Eq 1, Eq2 and Eq3.

$$Potential\ value\ of\ Physical\ aspect(V_p) = Potential\ value\ of\ parameter\ 1(P1) + Potential\ value\ of\ (P2) + Potential\ value\ of\ (P3) + Potential\ Value\ of\ (P4) + Potential\ value\ of\ (P5)$$ **{Equation 1}**

$$Potential\ value\ of\ Social\ aspect(V_s) = Potential\ value\ of\ Social\ parameter(S1) + Potential\ value\ of\ (S2) + Potentail\ Value\ of\ (S3)$$ **{Equation 2}**

$$Potential\ value\ of\ Environmental\ aspect(V_e) = Potentail\ value\ of\ Environmental\ parameter(E1) + Potentaial\ value\ of\ (E2) + Potentail\ value\ of(E3)$$ **{Equation 3}**

4.3.3 Analysis of tourism potential evaluation in six sites of Uttarakhand

"Weighted Sum Method" a popular multi-criteria decision making tool, has been adopted for computing the total tourism potential of each site. In this method, the total potential values of V_P, V_S and V_E have been normalized and then summed up after applying suitable weights for each aspect. Differential weights have been assigned to the three aspects based on their importance for increasing the tourism potential. The weights given on a scale of 100 are physical aspect (40) ,Environmental aspect (40) and Social aspect (20). Eq.4, Eq. 5 and Eq.6 has been used to calculate the normalized value and hence the total tourism potential Vt has been calculated for each site using Eq. 7.

$$Normalized\ V_p = \left(\frac{V_p}{25}\right)$$ **{Equation 4}**

$$Normalized\ V_s = \left(\frac{V_s}{15}\right)$$ **{Equation 5}**

$$Normalized\ V_e = \left(\frac{V_e}{15}\right)$$ **{Equation 6}**

$$Total\ Tourism\ Potential(V_t) = (Normalized\ V_p \times 40) + (Normalized\ V_s \times 20) + (Normalized\ V_e \times 40)$$ **{Equation 7}**

Table 2a: Rank assignment to the physical parameters

No. of Hotel (P1)	Type of hotel	Types of transportation (P2)	Distance	Vehicle accessibility (P3)	Vehicle arrival time	Ranks
>25	Star hotel	Bus, Railway and air facility	Within 5km	Deluxe or semi delux buses, taxi, autocabs	within 30 min	5
16-25	resort	Bus, Railway and air facility	5-10kms	Delux or semi delux buses, taxi, autocabs	every hour	4
11-15	Budget hotel	Bus, Railway facility	10-15 kms	Private buses and taxi	within 1-2 hr	3
6-10	Lodges	Bus, Railway facility	15-20 kms	Private buses and taxi	within 2-4 hr	2
1-5	Dharamsaala	Only bus and taxi facility	> 20kms	No buses are available only taxi	not scheduled	1

Table 2b: Rank assignment to the physical parameters

Nearby cities (P4)	**time taken**	**Others (banks, ATM, Petrol pumps) (P5)**	**At Distance**	**Ranks**
within 10-15kms	<25 min	facility of banks,ATMs and petrol pumps	Within 5km	5
within 15-25kms	25-40 min	Facility of banks,ATMs petrol pumps.	5-10 kms	4
Within 25-45kms	40-60 min	Facility of banks and petrol pumps.	10-15 kms	3
within 45-75kms	1- 1:30 hr	facility of banks and petrol only purchase by local traders	15-20 kms	2
>75kms	>1:30 hr	cooperative banks and no petrol pumps	>20km	1

Table 3 : Rank assignment to the Social parameters

Recreational activities(Mall, Parks)(S1)	**Security(S2)**	**Health facility(S3)**	**At distance**	**Rank**
Facility of Malls and Parks	Facility of police station	Facility of govt. and private hospitals, PHC and medical shops.	Within 5kms	5
Facility of Malls and Parks	Facility of police station	Facility of govt. and private hospitals, PHC and medical shops.	5-10kms	4
Facility of Malls and Parks	Facility of police station	Private hospitals, PHC and medical shops.	10-15kms	3
Only park or mall facility	Facility of police station	only medical shops or private hospitals	15-20kms	2
No malls and parks	No police station	No govt. hospitals only medical shops or private hospitals	> 20kms	1

Table 4 : Rank assignment to the Environmental parameters

Best time to visit (E1)	**Average temp(°C)**	**Elevation/altitude (m)(E2)**	**Threat/disaster (E3)**	**Rank**
Jan-Dec	<15°C	>1500	No threat	5
Feb-Oct	15-20°C	1000-1500	less threat	4
March-Nov	20-25°C	500-1000	Medium threat	3
Oct-May	25-30°C	250-500	High threat	2
Feb-April and Sep-Oct	>30°C	100-250	High threat(disaster prone area)	1

5 RESULTS AND DISCUSSIONS

5.1 Land use/Land cover (LU/LC) distribution and Change analysis of six sites

In this study, totally, six LU/LC classes have been considered viz., monument, river, vegetation, built-up, fallow land, road, DronaSagar (waterbody) and infrastructure. The site –wise image chips from both the data sets viz., Landsat ETM+ merged with PAN band (2001) and Cartosat 1 + LISS IV fused data (2010), have been visually interpreted and different LU/LC categories have been delineated. For each site, different landuseclasses percentage areas have been computed. The two landuse / landcover maps have been compared to identify the changes that have occurred in and around the sites. For e.g. in LU/LC (2000-01) of Site 1(Kalinga monument) only 3 % of land area is engaged in road but in LU/LC (2009-10) 21% of area is covered by road. This percentage difference of road class between 2000 and 2010 images shows increased development of infrastructure and thereby urban development. A similar analysis has been carried out for each site class-wise. The change in landuse classes is shown in Figure 3 for the six heritage sites. It can be observed from the Figure 3 that negative change has happened in the regulated zone of the site management area. The area statistics are given in Table 5.

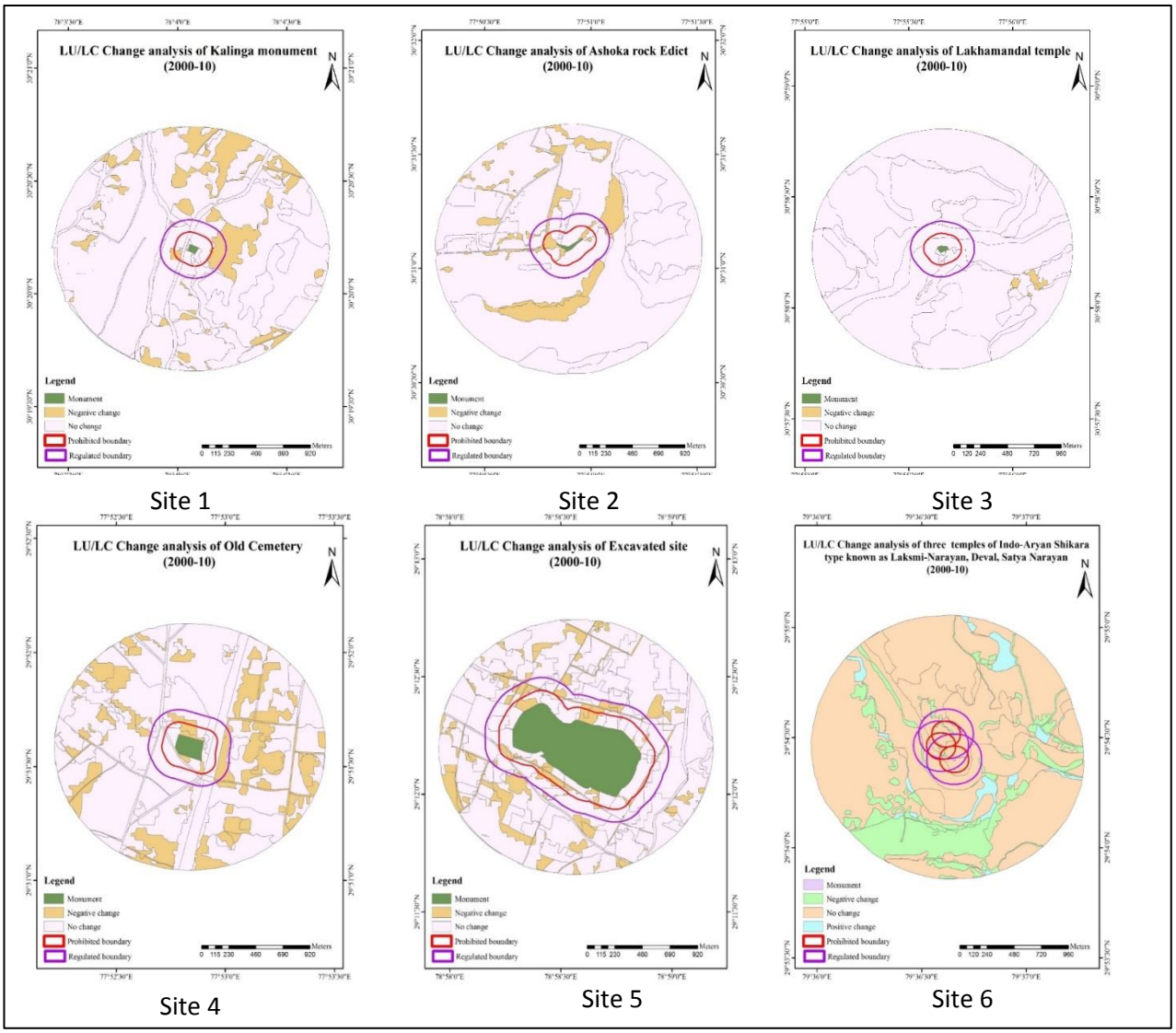

Figure 3: Landuse landcover change analysis for six heritage sites

Table 5: Change in the landuse landcover area over a period from 2000 to 2010

	Monument Area(Ha)	**No Change(Ha)**	**Negative Change(Ha)**	**Total Area(Ha)**
Site 1(Kalinga monument)	0.367	278.06	39.41	317.84
Site 2(Ashoka rock edict)	0.48	288.05	29.92	318.46
Site 3(Lakhamandal temple)	0.33	312.31	1.72	314.36
Site 4(Old cemetery)	3.04	244.45	67.74	315.24
Site 5(Excavated site)	38.08	20.36	38.8	313.56
Site 6(Three temples of Indo-AryaShikara)	0.11	288.67	60.64	362.45

5.2 Evaluation of tourist potential in six sites of Uttarakhand

In the present study, tourism potential of the six selected heritage sites has been computed and evaluated for the gaps. The table 5 gives the ranking of each site parameter-wise and aggregate potentials of physical, social & environmental aspects. From the table 5, it seen that with respect to physical parameters, Site 1 has the highest aggregate potential followed by Site 4 and Site 5. A similar trend is observed with respect to aggregate potential value of social aspect. This is due to the fact that Site 1, Site 4 and Site 5 are located in Dehradun, Roorkee and Kashipur cities However in case of aggregate potential value of environmental aspect, Site 3 followed by & Site 6

Table 6: Aggregate potential value of physical, social and environmental aspect

Heritage site	**P1**	**P2**	**P3**	**P4**	**P5**	**Vp(Eq.1)**	**S1**	**S2**	**S3**	**Vs (Eq. 2)**	**E1**	**E2**	**E3**	**Ve (Eq.3)**
Site 1(Kalinga monument)	4	5	5	4	5	23	5	5	5	15	3	2	4	9
Site 2(Ashoka rock edict)	3	2	3	2	3	13	2	4	4	10	4	2	3	9
Site 3(Lakhamanda l temple)	2	1	2	1	3	8	3	3	3	9	5	5	2	12
Site 4(Old cemetery)	5	4	5	3	5	22	5	5	5	15	2	2	4	8
Site 5(Excavated site)	4	4	3	4	4	19	4	5	5	14	3	1	4	8
Site 6(Three temples of Indo-Arya Shikara)	1	1	2	2	1	7	1	2	2	5	4	4	2	10

The Total tourism potential has been classified into four classes viz., Very High >75 score, high 50-75 scores, medium 25-50 scores and low <25 score. In Table 7, it is seen that Site 1(Kalinga monument, V_t=80.8) and Site 4 (old cemetery V_t=76.5) have relatively very high tourism potential which indicates that level of all the facilities such as availability of tourism infrastructure, tourism attraction near destination and quality of service provided to the users is better than the other heritage sites which itself increases the potential of heritage site and makes the first choice for the tourist. Site 5 (Excavated site, V_t= 70.4), Site 2 (Ashoka rock edict, V_t=58.13) and Site 3(Lakhamandal temple, V_t=56.8) with high tourism potential and last heritage site in Site 6 at Garur, Bageshwar known as three temples of Indo-Aryan Shikara type (Lakshmi-Narayan, Deval, Satya Narayan temple) has medium tourism potential (V_t=44.5) because of having minimum facility of tourism infrastructure for e.g. vehicle accessibility, less accommodation facility and transportation facility. Hence there is less tourist's inflow in this place.

From the study, it is observed that the physical aspects play an important role in determining that tourist inflow at any heritage site. Improvement of the physical aspects such as road connectivity, transportation facility and accommodation facility will improve the tourist inflow.

Table 7: Tourism potential of heritage sites

Heritage site	Normalized Vp (Eq.4)	Normalized Vs (Eq.5)	Normalized Ve (Eq.6)	Total tourism potential V_t(Eq. 7)	Classification of Total Tourism Potential V_t
Site 1	0.92	1	0.6	80.8	Very High
Site 2	0.52	0.66	0.6	58.13	High
Site 3	0.32	0.6	0.8	56.8	High
Site 4	0.88	1	0.53	76.5	Very High
Site 5	0.76	0.93	0.53	70.4	High
Site 6	0.28	0.33	0.66	44.2	Medium

.

6 CONCLUSION

This study presents the results of monitoring and tourism potential evaluation of six nationally important sites of Uttarakhand using geospatial techniques. High resolution satellite images of two times viz., Landsat ETM data of 2000 and CARTOSAT+LISSIV fused data of 2010 have been used for generating Landuse/landcover maps within 1km buffer of the heritage sites which encompasses site management zones also. The landuse change analysis has been carried out and three types of changes have been identified, viz., no change, positive and negative change areas. The results have shown that negative changes have occurred within the site management zones of heritage sites, more so in the sites occurring in towns/cities. It ranges from 0% to 38%. These negative changes indicate that the monument/heritage site is under threat of encroachment and also that the heritage bye laws may not be implemented in strict compliance. Thus, using the satellite data it has been possible to monitor the LU/LC changes occurring over the decade and also to identify the heritage sites which are under threat and need to be conserved.

Another important component was to evaluate the tourism potential of these sites, by which one can increase the economy of the place. A normalized weighted sum method of the parameters has been used to carry out the tourism potential evaluation. The sites have been studied for three aspects viz., physical, social and environmental. Under each aspects, different parameters have been identified and rankings have been assigned based on the literature and experts opinions. A total tourist potential has been computed and all the sites have been classified into four categories (very high, high, medium and low). In the study, it has emerged that only Site 6 has medium tourist potential which needs to be enhanced by way of improving the parameters of physical aspect like transportation and accommodation facility near the heritage site.

From the present study it is seen that monitoring of heritage sites over time and space is an important component for conservation and protection and effective management of heritage sites. The geospatial techniques used in the present study helps in identifying the sites which are under threat of encroachment within the site management zones. Hence a systematic monitoring of all the important heritage sites is an important exercise to be routinely carried out for proper and efficient management of sites. Tourist potential evaluation helps in identifying the gaps in the tourist infrastructure and the actions that needs to be taken by the policy formulators/government to improve the tourism and thereby improve the economy of the place.

Acknowledgement

The authors would like to thank Director, NRSC for the encouragement given for carrying out this research work. The contribution rendered by Archeological survey of India (ASI) team in the study is duly acknowledged.

References from Journals

1. B. S. S. Sankhala, "Evaluation of urban sprawl and land use land cover change using remote sensing and GIS techniques: a case study of Jaipur City, India," International journal on Emerging technologies, p. 66–72, 2014.
2. M. R. K. Ibrahim RizkHegazya, "Monitoring urban growth and land use change detection with GIS and remote sensing techniques in Daqahlia governorate Egypt," International Journal of Sustainable Built Environment, p. 117–124, 1, June 2015.

3. D. K. Pareta, "Remote Sensing AndGis Based Site Suitability Analysis For Tourism Development," International Journal of Advanced Research in, pp. 43-58, May 2013.
4. P. I. Corneliu, "A critical analysis on the evaluation of tourism attractiveness in Romania.Case study: the region of Moldavia," in Proceedings of the 5th WSEAS International Conference on Economy and Management Transformation (Volume I, ROMANIA) , 2010.
5. S. H. Kaberi Samanta, "Landuse / Landcover change study of Jharkhali Island Sundarbans, West Bengal using Remote Sensing and GIS," International Journal Of Geomatics And Geosciences, Volume 3, No 2, 2012 , pp. 299-306, 2012.
6. U. H. G. S. Mario Hernandeza, "Earth Observation from Space for the protection Of UNESCO World Heritage Sites: DLR Assisting UNESCO," The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences. Vol. XXXVII. Part B8, pp. 643-646, 2008.
7. N. M. Noor, "Geospatial Analysis In Monitoring Land Use Encroahment Into Heritage Site In Bujang Valley," Journal Of Architecture, Planning & Construction Management, 2015.
8. K. T. D.G. Hadjimitsis a, "Utilizing Geographical Information Systems (Gis) & Satellite Remote Sensing Analysis For Integrated Planning: A Case Study Of Paphos District Area - Unesco World Heritage Town (Paphos, Cyprus)," in XXI International CIPA Symposium,, Athens, 2006.
9. D. A. N. GUPTA, "Web Enabled Heritage Information System -A Case Study of Bundi District (Rajasthan)," South Asian Journal of Tourism and Heritage Vol. 8, No. 1, pp. 56-62, 2015.
10. AnamikaPoonia, "Applications of Remote sensing and GIS in Tourism potential Evaluation," International Journal of Remote Sensing and GIS,Volume 2,Issue 1,pp. 11-20, 2013.
11. S. M. Abdulla Al Mamun and Soumen Mitra, "A Methodology for Assessing Tourism Potential: Case Study Murshidabad District, West Bengal, India," International Journal of Scientific and Research Publications, Volume 2, Issue 9, pp. 1-8, 2012.
12. Y. Yuan, "Potential evaluation of tourism development based on multi-level grey theory," in International Conference on Management Science and Industrial Engineering (MSIE), , Harbin, 2011.
13. M. Mamun, "A Methodology for Assessing Tourism Potential: Case Study Murshidabad District, West Bengal, India," International Journal of Scientific and Research Publications, Volume 2, Issue 9, p. 8, 2012.

References from websites

1. K. Mukesh, "Geospatial monitoring and evaluation of UNESCO world heritage forest areas in the Tropics," Umeå , 2009.
2. bhuvan.nrsc.gov.in/governance/culture_monuments