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INTERDISCIPLINARY JOURNAL
OF
DIGITAL HUMANITIES
AND
UBIQUITOUS SCHOLARSHIP

IJDUS

Volume I Issue II July – December 2022 ISSN: 3048-9113 (Online)

Chapter VI

Geo-mapping the Himalayan settlements

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Abstract: This chapter delves into the use of geospatial analysis to study and preserve cultural heritage landscapes, using Kangra Fort in Himachal Pradesh as a case study. The chapter explores how Geographic Information Systems (GIS) and remote sensing technologies can provide insights into the historical evolution of landscapes, detect changes over time, and identify buried heritage features through techniques such as crop mark analysis. By overlaying satellite imagery, historical maps, and digital elevation models, the study reveals the strategic importance of Kangra Fort and its surrounding natural defenses. The research emphasizes the importance of integrating modern geospatial tools with historical texts and ground truthing to improve the conservation and documentation of heritage sites. The chapter also highlights the limitations of accessing old maps and satellite imagery but underscores the potential of GIS in cultural heritage management.

Keywords: Geospatial Analysis, Cultural Heritage, Kangra Fort, GIS, Remote Sensing

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Vol. II, Issue I, January – June 2023

Chapter VI

Geo-mapping the Himalayan settlements

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My topic is geospatial analysis of cultural heritage landscape, case study of Kangra fort in Himachal Pradesh. Before going into my case study, I would like to give a brief introduction of what exactly is geospatial analysis and how it has been used in analyzing cultural heritage. So basically, what at the initial stage, what GIS or what geospatial analysis does is it gives a brief idea on the entire landscape of a feature.

Because it's not necessary that when we are in a fort, it's not necessary to look at a fort with its different aspects with the geography of the fort, the entire landscape of the fort, the features of the fort, such as moat area or an adjoining river or the settlements which have been there or which are existing. So such things in heritage help using such analysis helps us to identify that and adds to our knowledge system. It of course, goes without saying that it is not exclusive and the use of remote sensing images and GIS analysis, it goes hand in hand with our old maps with the settle with the historic historical text that is available as present.

And also, such type of studies help us in digitizing whatever, whatever heritage we have at present, I have brought in a few minor examples at how these this technology is guiding us towards the betterment for the for the for our heritage in general. And the study of spatial context, I would like to give a very brief example of how it started at first, then I'll go into my case study at Kangra Fort. So in 1944, there was an archaeologist Gordon Wiley, who first started witnessing or who first started viewing heritage landscapes in Peru in Beirut Valley and the the aerial photographs which the entire team of Gordon Wiley had, they came up with a with a very interesting approach on how to witness a site.

In this example, I'll just let you show by the image. And in image A, there are a couple of dots, I'll just add my pointer. Yeah, I hope you guys can see my pointer. So, there are two two dots which the archaeologist has marked. And these depict certain archaeological features, certain settlements. And as he as he identified further features on ground on the map, and also, he did

some ground truthing, which is going and validating the feature that were present, there were more things which he marked on the aerial photographs.

And in further as he marked further settlement areas for the architectural features for the archaeological remains and mounts, the team not only got to know how the area must have grown into but they also got a good idea how it must have evolved with with these ground with these images. So, this is a very basic image that I wanted to give before going further into the analysis. Going further, one of the most basic or one of the basic criteria of identifying features when we use any satellite image or when we use any aerial photography is the identification of crop marks.

Now what exactly crop marks are, it's very important to understand before we further go into our study is crop marks is nothing but how landform shapes due to certain ground remains which have been which have been due to the built-up features in the past. In this photo, as you can see, the area where the port remains of, for example, there would have been a port and this port feature is now under the buried under the ground, but the soil doesn't get enough nutrients. So, the vegetation, any sort of vegetation, it's, it's called a crop mark, but any sort of vegetation, understand this as a vegetation, any sort of vegetation will, will not be thrived around the area.

And it's not a random thing that you just try and see any sort of vegetation. Of course, as I mentioned earlier, as well that you have to take in the accounts of old maps, you have to take in the accounts of survey of different kind of survey of different states map, you have to take in the accounts of historical text, you have to see where the exact fortification could have been. This is just an example of how you can come up with or how anyone can come up with this type of analysis.

And in the second one, as you can see, had there been a moat around an area around a fort surrounding a fort, and this moat would have enriched the nutrients in the soil and the vegetation corresponding to this soil would would grow further. And this differences, these differences are what we define as crop marks in our GIS analysis. And this is a this is one of the prime features that we use.

And there are examples in my Kangra Fort study that I have tried to come up with such features. And as I mentioned, there are negative and positive crop marks as vegetation takes a growth due to further analysis of due to further filtration of nutrients in the soil, the vegetation has a thick growth. And this is known as positive crop mark that you have a vegetation to go with.

And when there are less amount of vegetation, it is naturally called a negative crop mark. These crop marks can also be witnessed in satellite images, using infrared images, which, which is primarily used by use a lot by people who study heritage and landscape nowadays. Okay, so Google Earth Pro is a free source that we all know, and the usage of it is quite extensive in heritage analysis.

So, the first thing I would like to show you is this is the fortification around Sravasti in Uttar Pradesh. And the image a there, as you can see the image, there are two images. And if you see around this, there are certain changes that have taken place.

Now I'll show you this photo was taken in December 1984. This is a temporal study of Google Earth images. And this one was taken in December 2014. So roughly 30 years. And if you see in 30 years, the first differences are the meandering of the river which has been shown up here. And the second is you can see the crescent form of the fortification or around this area is has changed a bit.

And also, the settlements have thrived in around the fortification of Sravasti. This this has been done in 30 years If you see this area, and if you see this area, a sort of settlement has come up with and also around this and this. So, within 30 years, we see a such a big difference in any heritage site.

So, if the use of geo-station analysis in landscape and cultural landscape is that if we have certain references to go by with say if we have old map or in India, there were so many British maps that are available, especially in if you talk about Himalayan region, there are so many maps that are available. Accessibility is still an issue with that I'll come up with the limitations as well. But this is an example.

There's another example of how, as I mentioned that the documentation or the use of geospatial analysis can further help us in preventing heritage structures. This image is as you can see, in this image, there is a foot in at NH 7. And it was well preserved in 2010. And there was this the highway had to be broadened.

So, they first broadened the highway from the left, as you can see, and in 2012, the highway had to be broadened further. And for that, the fortification has been destroyed. And in 2018, you can see the almost more than half of the port area has been destroyed. So, these things can be now identified and Google Earth Pro is now evidence of how heritage can be managed. These are few features of GIS analysis, which I have used in my preliminary study of Kangra

port. As coming into Kangra port in the, sorry, I'll give in detail of these features of GIS analysis further as I give, as I continue with my study.

So, starting with Kangra Fort, and why? So, first of all, giving a brief introduction of the port, it was around, it was built, it's mythologically said that it was built after the Mahabharata war and Mahabharata war and it was built under Katoch dynasty. But the important thing about Kangra port was that it was supposed to be one of the biggest Fort and the most important port. And it has around four-kilometre length of fortification and the vista that was created that you can keep an eye from all direction, all directions and it was at such a strategic location, which I have tried to suggest a visualization that you can see.

So, I'll tell you the methodology. First of all, the primary basic thing is using Google Earth imageries and analyzing the temporal changes, which would have taken in 10 years or 20 years because Google Earth imageries at max for some areas can give us up to, as we saw in Sravasthi case, up to 1984, 1985. But that is not necessary that we get for all areas.

So, it has that limitation. The next is Corona satellite image. So, Corona satellite was an air balloon satellite that was used around 1960s 1970s during the Cold War and the photos and the photograph that it has are quite good quality. And now it has been declassified in US and anyone can easily access now. Of course, some photos are not free, but most of them are easily accessible and one can use that help in their analysis. The important thing about the landscape of Kangra Fort is Alexander Cunningham in his report also mentioned that it is it was popularly said around that time that the one who conquers Fort Kangra or Fort Kangra conquers the hill.

Based on landscape analysis, a visual understanding can be done on the strategic location of the fort, which I'll try to do. And I'll try to further create a paper on this as well. So, starting with temporal changes in Google Earth Probe, this is a very, this is a visualizing the brief features of basic features in and around the fort and the two rivers and old settlement of Kangra.

So, as you can see, I just mentioned that this is the Kangra Fort as we know, the entire region around this is the fortification that was still that was made in the original plan, but how much is still existing or where exactly the location of these fortifications could have been or what other features were there or could be there. I have tried to throw a light on that. Then there are two rivers around this that that photo gives them a natural mode, which is a very important feature for any fortification to as a defensive approach.

Then this is the old settlement, old Kangra, which was the settlement around the eastern part of the Citadel Fort. So now, according to the historical text, Cunningham says that only the fort was accessible only through the eastern part. There was no accessibility around this part.

And this was majorly a great weapon for anyone who captures Kangra Fort and the history of Kangra Fort says that even rulers like Ghazni, Feroz Shah, Tughlaq and even Britishers tried to capture that and most of them were successful also because of the importance and because of the wealth Kangra had. As I go further, there are two images of Google Earth Pro. One is of 2003 and the other is of 2014.

The fort features and there are two things which I wanted to highlight are fort features and crop mark near tank. Coming up to fort features, as you can see on the pointer, the major Citadel is present at here. And according to ASI protected site also, they have mentioned that the fort would have been around this area, which I'll show you further.

But the identification and the possibility of finding new things around the area, especially because in 1905, a major earthquake occurred in Kangra, which recorded that most of the structures which would have been there were destroyed, were destructed in that earthquake. So, it's important to analyze through this means as to see what could have been there. So around this, if we see in Google Earth image of 2014, we can see the change in from this to this that a fort feature which resembles a fortification is seen.

Why? Because it's not, as you can see, it's coming at a uniform shape and that's the reason it can be a fort boundary. The second thing is crop mark near tank. This tank, according to the text is known as Raniki tank.

And around this tank, you can see if you are able to visualize, there is a crop mark sort of there's a pattern around this and this needs to be further analyzed. The reason why I'm saying this needs to be further analyzed is that there have been several incidences, several case studies on such patterns, especially around a tank, which have given us further details of anything, of any mounts, of any ruins. So, this needs to be analyzed further.

And for that, one of the most important things is ground truthing, which I'll again come into my limitations of the study. As I go further, this is georeferencing and overlaying of old Kangra plan. This is a plan I found on ASI's website.

And these are all the methodology or all the features which I have used for this analysis. And as I georeference this, basically what georeferencing is when you give lat longs to when you

give coordinates to an old map and overlay it on a present-day Google map base. So, with that, you can identify that, okay, this was the watch tower.

So, at present watch tower is there and you can analyze it with the surrounding images. As you can see the port area, it's mentioned that it could have been, it was present there or the dotted line suggest that before the earthquake, it was there. So, in this, you can easily check out the area and see where exactly the port remains or what could have been there.

This is just a preliminary study of Kangra Fort plan which I have done. And it's subject to further analysis, it's subject to further maps, I there are a lot of old maps of Kangra district. During British time, it's, it's still it's, unfortunately, it's not accessible at the moment, it's in British library, we have mailed to them, we are still waiting for them to give access to some of their maps. And in the past, what what our institute has done is they have got access to old map because it's very important that we use those maps to come up with authentic conclusions. Now, this is a satellite imagery. This image is of September 1972.

So, as you can see, if you can, if you remember the settlement, I showed you this, I'll just mention again where the port is. First of all, it's very, these maps don’t come georeferenced themselves by georeferencing. I mean, you, if you put it on any tool, it won't be overlaid automatically, you have to give coordinates to them to come up at the same location as the present day, Google features are, and it's important to identify where the exact what your area of study is.

So, this is the food area. This is the running the tank that we talked about in the earlier Google Earth images of 2003 and 2014. This is the food for the food world fortification that we talked that maybe was still there. I wanted to show two settlements around one is the eastern settlement. To impact the food areas or impact the present-day food situations. In this one, I'm again talking about the crop mark which we identified in 2003 and 2014 image. And these crop marks are further subject to study. Because as I mentioned earlier, crop marks are our major redirections to provide us some detailed study. Now, this is a digital elevation model of Kangra.

And as you can see, I have marked the fortification of Kangra in this and also in in the 3d elevation models. As you can see, the as we go the the portion of the map which is in red, it suggests less elevation and the portion which which is in white suggests more elevation around the hilly areas. As if you if you take this example, the fortification is around like this and there are two rivers going through it. And it works as a natural mode for it. Because this way the defence is much more important and much more robust if you have and it it also gives an idea

of how the plan of the port would have arrived at why this location why not this location or why not this location. It is very important to understand the landscape area as well what could have been the backdrop of giving this location only.

As we can see in the 3d elevation map around this area of the Fort, there are the port is now covered at three sides from this from this and from this and from around the southern side, the river is going. If we look at the defensive purposes of the port, it's very strong and hence it was right throughout the history it was always claimed that one who captures Port Kangra captures the hilly areas. Now I again want to come up come back to the present day and how the ASI boundaries are defining the or helping us define the structure and how the management authorities can take up certain actions.

The red line is the protected area the yellow is as we know how the ASI boundaries work is prohibited and the green is the regulated but yet the settlements have been made around this area. So as per for documentation as well and now many historians and many archaeologists also have started to use ISRO's Bhuvan portal which gives us a nice digitization of the features that we have. Now coming up to the limitations of my work as I talked about and this is still my work is still at a preliminary stage of the study of Kangra Fort it is still subject to receiving old maps from British library it is still subject to receiving satellite images of stereo pair and Landsat.

The first thing was ground truthing it's very important to whatever we visualize in the in our GIS analysis to check and see there because that is when the entire authenticity of the work comes. Also, it gives a you know good closure good conclusion to whatever we have found and whatever we see on the ground. The second as I mentioned is the usage of old maps.

At present this is my preliminary study of the Kangra Fort. In future, as I wish to write a paper on this, I would like to do further analysis on it as well. I would like to acknowledge people who have really helped me in this- Dr. Niraj Kumar Singh, Dr. M B Rajni who is my principal investigator at my current institute. And I would like I would also like to hand in search team and my geospatial team of National Institute of Advanced Studies Bangalore and Ritwika Singh for helping me with the content.

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DIGITAL HUMANITIES
AND
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IJDUS

Vol. II, Issue I, January – June 2023

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