

*Type of the Paper (Article)*

# The sacred landscape of the "Pyramids" of the Han emperors: a cognitive approach to sustainability.

Giulio Magli<sup>1</sup>

<sup>1</sup> School of Architecture, Urban Planning and Construction Engineering, Politecnico di Milano, Italy.

\* Correspondence: Giulio.Magli@Polimi.it; Tel.: +390223994568

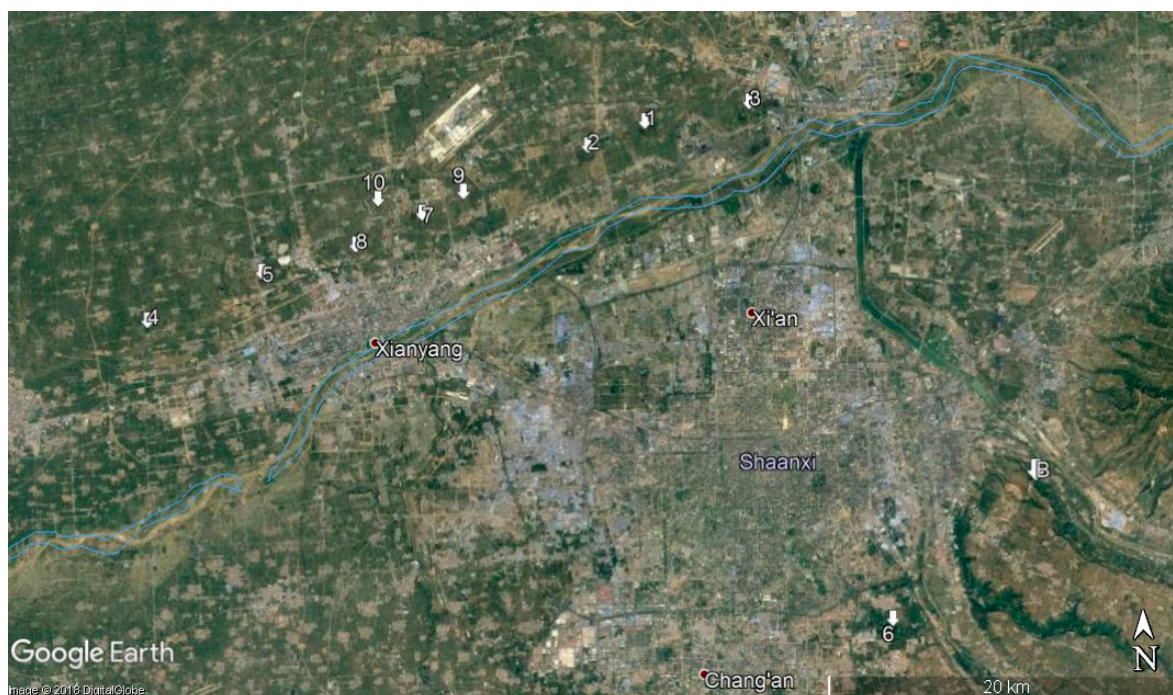
**Abstract:** The so-called “Chinese pyramids” are huge burial mounds covering the tombs of the Emperors of the Western Han dynasty. If we include also the mounds of the members of the royal families, these monuments sum up to more than 40, scattered throughout the western and the southern outskirts of modern Xi'an. They are mostly unexcavated and poorly known although, taken together, they form a fascinating sacred landscape, which was conceived as a perennial witness of one of the most magnificent Chinese dynasties. This sacred landscape is today encroached by the frenetic urban development of the Xi'an urban area. We discuss and elaborate here some of the results of a recent, new satellite-imagery survey of these monuments, highlighting the aspects which may contribute to solutions for a sustainable and compatible development within this important ancient landscape.

**Keywords:** Chinese Pyramids; Han Dynasty; Feng-Shui; Protection of ancient landscapes

## 1. Introduction

The Western Han dynasty of ancient China (202 BC – 9 AD) marked important political, economic and scientific developments. The Han rulers followed the custom initiated by the first emperor of Qin - whose mausoleum is world-famous due to the terracotta army guarding its eastern side - and choose to be buried in tombs located under huge square mounds of rammed earth, today known popularly as “Chinese pyramids” [1].

These monuments are located in the outskirts of Xi'an (Fig. 1). A main group of them, composed by 9 emperor's tombs and 21 satellite tombs of members of the royal families - is located along the northern bank of the river Wei, in a area close to the airport and subjected in recent times to high population growth and urbanisation within the “Xixian” new area projects. A second group of monuments is located to the south of Xi'an, not far from other high-impact areas related to high tech and tourism development zones.



**Figure 1.** The burial mounds of the emperors of the Western Han Dynasty. 1 Gauzu (Chanling), 2 Hui (Anling), 3 Jing (Yanling), 4 Wu (Maoling), 5 Zhao (Pingling), 6 Xuan (Duling), 7 Yuan (Weiling), 8 Cheng (Yangling), 9 Ai (Yiling), 10 Ping (Kanling). The mountain tomb (Baling) of emperor Wen is denoted by B. (Image courtesy Google Earth, editing by the author)

The Han mausoleums are thus a fascinating, almost “alien” presence in the rapidly developing landscape of modern China. They have been poorly studied and only two have been (partly) excavated, those of Emperors Jing and Wu. It is rather difficult today, on site, to have an idea of the ways in which this funerary landscape was conceived, and especially of the visual relationships the monuments bear to each other. This is due to various factors, but chiefly to pollution – which drastically reduces horizon visibility – and to the sheer difficulty of reaching some of the monuments and/or their tops. For these reasons, although I have personally visited many of them, I decided to carry out a new, complete survey using satellite imagery tools. The result of this campaign have been recently published in a specialized archaeological Journal [2]. In the present paper I discuss and expand some of the results obtained, focussing on the problem of a sustainable development of this area so rich in cultural, almost unexplored relics.

## 2. Materials and Methods

The monuments have been surveyed on site whenever possible (some are of difficult or no access). However, they are in any case very difficult to measure due to vegetation, fences, and to the fact that the sides are not always clean. Therefore, we took advantage of the fact the area is well covered by satellite imagery (both on Google Earth and Bing), with a resolution which is more than sufficient to measure the average sides and average azimuths of the mounds. Another problem that satellite imagery is helpful in solving is that of the ancient horizon. Indeed, the horizon visibility today is very poor – due to pollution



– even when the horizon is clear of building; moreover, modern buildings are present. Using satellite tools it is instead possible to establish whether monuments had mutual inter-visibility in the past or not. All in all, the available images - in many cases, the historical archive of Google Earth contains more than one image with a sufficient resolution – were extracted and measured with autocad for length of the sides, orientation, and directions of visibility towards other monuments. The results were mediated in presence of more than one image. Errors have to be expected of course, but on account of the high quality of the images and of the low projection error associated with them, the intrinsic error expected from this kind of measurement is quite low, so that Google Earth is a quite useful tool for this kind of investigations [3,4]. Unfortunately however, the original heights of the mounds (certainly greater than the current ones) are impossible to determine because the summits have deteriorated considerably (Fig. 2).



**Figure 2.** The huge mole of Maoling, the tomb of emperor Wu of Han, looks as a natural hill. It is, instead, fully artificial: a pyramid made of blocks of hardly rammed earth. (Photograph by author).

### 3. Results

As a first result, the satellite imagery analysis has shown the presence of two different patterns of orientation of the square basis of the pyramids. This result is only of side interest here and will therefore be only briefly recalled. A first group of monuments is precisely oriented to the cardinal points, with errors not exceeding  $\pm 1^\circ$ , while a second group has errors in relation to the geographic north of several degrees. These errors are not random: they are always to the west of north and exhibit a tendency to decrease in time from a maximum of  $14^\circ$  to a minimum of  $8^\circ$ . The mounds of the first group were oriented by determining the cardinal directions, while the skewed orientations of the other group can

85 be explained as pointing the maximal western elongation of Polaris, which was at those  
86 times – due to precession – not coinciding with the celestial pole, located in a dark region.  
87 These orientations are symbolic, as both the North celestial pole and the circumpolar region  
88 were of paramount importance for the Chinese: the function of the pole as “pivot” of the  
89 sky was, in fact, equated with the centrality of the imperial power on Earth, and the whole  
90 polar region of the sky was identified as a celestial image of the Emperor’s palace, the  
91 “Purple Enclosure” [5]. The different choices made by different emperors (cardinal  
92 orientation, or to Polaris) have still to be analysed in details in historical terms; they are  
93 certainly related to their conception of the mandate of the heaven and to the role of  
94 Confucianism in the royal court.

95 The above mentioned results exclude the use of the magnetic compass (first invented in  
96 China precisely during the Han) for the orientation and placement of the pyramids, and  
97 therefore the use of the the traditional Chinese pseudo-scientific doctrine of “geomancy”  
98 (Feng Shui) with compass measurements. Similarly, also the standard canons of Form Feng  
99 Shui, based on the presence of a mountain to the north of the site, smooth hills to the east  
100 and west, and water and protective hill to the south, which were applied in the necropolises  
101 of several subsequent dynasties [6,7] are here clearly excluded, since the monuments lie in  
102 the flat plain. We arrive in this way to the results of this research which are of main  
103 relevance for our discussion here, and will be further expanded and elaborated: these  
104 monuments were planned one after the other but taking into account the already existing  
105 ones, in order to form a *sacred landscape*, where *mutual placement* and *inter-visibility*  
106 played a key role.

107 Let us consider, first of all, the distribution of the monuments in the western  
108 necropolis. The tombs are located along a direction of azimuth of about 72 degrees, roughly  
109 following the river with an average distance of 4.5 km from today's banks. The distance as  
110 the crow flies from the westernmost emperor’s monument, Maoling, and the easternmost,  
111 Yangling, is about 35 Kms. One would expect the easternmost tomb to have been built  
112 first, because it is the closest to the Han capital Chang'an, and the others to have been built  
113 in succession from east to west. However, it is not so: they were not built in a linear  
114 succession, and many “jumps” back and forth occurred. The jumps can be explained taking  
115 into account that historical sources, like the Book of the Han [8], mention a doctrine called  
116 *Zhaomu* which was used for the choice of location of emperor's tombs. The doctrine states  
117 that left/right (east/west) have to be alternately selected, so that, looking at a tomb, the first  
118 successive one will be found to the left (west) and the second to the right (east). From  
119 satellite imagery it is clear that this alternate distribution was followed for two triplets: the  
120 tombs of Gaozu, Hui and Jing (omitting the choice of a natural mountain made by Wen in  
121 between) and those of Yan, Cheng and Ai. Of special interest are the latter three, since  
122 their centres are connected by a straight line. This observation finally leads us to our main  
123 issue: inter-visibility. Indeed, where dynastic connections and topographical connections  
124 only intended in the projects, or instead they were explicitly visible, each day, looking at  
125 the monuments? To calculate the (theoretical) visibility of an object from a fixed position  
126 located at an height  $h$ , a simple formula can be used (essentially an application of  
127 Pythagoras' theorem). This “horizon formula” states that the visibility distance in  
128 kilometres equals the square root of the product of the number 13 times  $h$ , with  $h$  measured



in meters. So, for instance, a person two meters tall can look as far as the square root of 26 in kilometres that is, a bit more of five kilometres. Of course, for tall objects the horizon visibility increases considerably as the heights sum up. As mentioned, it is difficult today to assess which was the original height of the burial mounds; however, even considering only the heights they reach today it is readily seen that they were practically all inter-visible each other from their summits. For instance the distance as the crow flies from the westernmost emperor's monument, Maoling, and the easternmost, Yangling, is about 35 Kms. Still today the higher point of Maoling is about 47 meters, that of Yangling is about 25, giving a horizon visibility which is comparable to their distance. It follows that with all probability they were fully inter-visible at the time of their construction. Being these two pyramids at the two extrema of the land where all these monuments are located, we can conclude that these magnificent monuments were *all* placed in such a way as to "speak" each other along visibility lines from their summits. What is more, many of them were simultaneously visible from the ground. Still today, in spite of haze and pollution, it is possible to appreciate from each mound the presence of at least the closest other monuments (see Fig. 3).



**Figure 2.** Pingling, the tomb of emperor Zhao of Han, as seen from the Maoling group. (Photograph by author).

The "skyline" was made more fascinating by the presence of satellite mounds. In [1] we noticed without explanation the curious fact that the sides of the satellite mounds never align with the sides of the corresponding main mound. This looks odd because, as a consequence, the orientation procedure must have been repeated for each one of them separately, while construction in alignment would have much simplified their planning. However, it is now clear that in this way these mounds contribute to the skyline in a

significant manner, a thing they would hardly do in case of parallel alignment with their principal counterparts.

Let us consider now the tombs located in the area to the south-east of Xian. Here the situation is more complex as the first monument constructed, Baling, the tomb of emperor Wen, is not a artificial mound. Indeed Wen is the only Han ruler who selected a mountain for his tomb, and the funerary chambers were hollowed out of the rock.

Wen's funerary landscape comprises two satellite burials, those of his wife Empress Dowager Bo and of his daughter Empress Dou. These are huge, almost identical, rectangular structures located in the plain to the south-west of Baling. The tomb of Bo was orientated towards the Baling peak, which is visible when looking from the summit along the projection of the longest sides of the mound, at a distance of some 3.6 km; the tomb of Dou was a replica of that of Empress Bo, located further south. Later, another Emperor chose the same area for his tomb, Xuan. The diagonal of Xuan's mound passes quite neatly the apex of Baling, which was (barely) visible on the horizon, some 11.5 km away.

All in all, we can conclude that also the tombs of the southern group were conceived according to the idea of creating a sacred landscape of mutually visible monuments.

#### 4. Discussion

According to official reports, in the last 20 years thousands of Chinese cultural sites have disappeared, to make room for building projects. The number of endangered or cancelled sites is even higher than the average in the Shaanxi province. This should come as no surprise, as this area was the heartland of the Chinese civilization for so many centuries. It suffices to think that Tang's Xi'an in the years around 750 AD was the most inhabited city in the world, with an estimated population reaching 2 million people. Besides the sheer number of archaeological sites, another cause of this tragedy is that in Shaanxi rural areas are being rapidly transformed, with population density already of more than 230 people per square Km, increasing. A intense building activity, with the construction of compounds of five to ten high towers each, occurs in the suburbs of Xian, dangerously close to the area of the Han dynasty mausoleums. The recent history of Xi'an helps in explaining this urbanization phenomenon. During the 50's of last century, Xi'an was at the centre of a process of industrialization which brought to light many new industries. This process re-started after the Cultural Revolution and during the 70', also due to the remoteness of the territory which offered warranties for industries of military interest, such as aerospace. Finally, in the last two decades of the last century, urbanization and development were triggered especially by the projects called "New Special Development Zones".

Sustainability of urban development in China is of course an important, much debated issue [9-10]. However, at least as far as the present author is aware, the problem of compatibility between development and cultural heritage has hardly been brought to attention as a key problem. Of course there exists in China accurately preserved, magnificent sacred landscapes which are safe from any danger : it suffices to mention the

UNESCO site of the 13<sup>th</sup> tombs of the Ming dynasty. Alas, the same cannot be said of the tombs of the Han emperors which are, therefore, also an occasion to investigate on sustainability with respect to Cultural Heritage on an unprecedented scale. Let us, therefore, try to understand which points might be implemented in this direction, also taking into account that protection of the Han cultural relics is explicitly mentioned in the Governments' master plan for the Xi-Xi'an urban development area.

First of all, it has to be observed that excavations at Yanling – where thousands of miniature terracotta statues of warriors and animals have been unearthed – have shown that the pits of the funerary equipment of the emperors were disposed in a radial manner directly near the four sides of the burial mound. From this point of view the first emperor's burial, with the tremendously huge pits of life-size statues lying kilometres afar from the mound, has with all probability to be considered as a unique case. Thus, a minimal, urgent intervention must be the institution of a buffer zone enclosing each of the mounds by all sides for a few hundreds of meters to assure the possibility of future excavations. The buffer zone should be established also for the satellite burials, as several additional tombs and burial pits have to be expected in their areas [11,12]. By the way, a very recent discovery (press news of November 2018, yet unpublished) has shown that miniature terracotta army could accompany also the burials of members of the royal family: they have been discovered in what are probably the annexes of the tomb of Liu Hong, son of Emperor Wu of Han (141–87 BC) in Linzi.

Further to this, another aspect should be taken into account. Indeed we have shown here that the royal mausoleums have to be considered as an ensemble, which stands as an imposing icon not only of each divine ruler separately but actually of the Han dynasty as a whole. One may suppose this “landscape of power” to be related to the traditional Chinese “geomantic” doctrine, but we have shown that is not so: the magnetic compass was not used for orientations and the typical auspicious features of the territory are absent. Actually, although some elements of the tradition must be very old, the first written records about Feng Shui appear later, with the *Zang Shu* (Book of Burial) by Guo Pu (276–324 CE). It follows that trying to apply Feng Shui canons in future constructions, as sometimes proposed (see e.g. [13]) would have nothing to do with the way of thinking of the Han builders. For them, it was rather the inter-visibility and the imposing presence of the “pyramids” to play the key role. The Han mounds are “mountains where there are no mountains”: the floodplain on the northern bank of the river way is flat and each visible “hill” is actually a pyramid. It seems to me, therefore, that a feasible proposal is to respect the sacred landscape in which these imposing monuments were placed by avoiding construction of compounds along their inter visibility lines. To be more specific, new relevant buildings should be constructed in such a way as to allow the inter-visibility from each pyramid of at least the two nearest imperial monuments both to the east and to the west, so that the Zhaomu tradition remains effective and a glimpse of the ancient global planning of this wonderful landscape, conceived more than 2000 years ago, can still be taken.

**Funding:** This research received no external funding

**Conflicts of Interest:** The authors declare no conflict of interest



## 240 References

- 241 1. Zhewen, L. (1993) China's Imperial Tombs and Mausoleums. Beijing, Foreign Languages Press
- 242 2. Magli, G (2018) Royal Mausoleums of the Western Han and of the Song Chinese Dynasties: A Satellite
- 243 Imagery Analysis. *Archaeological Research in Asia*, Volume 15, September 2018, Pages 45-54
- 244 3. Potere, D., 2008. Horizontal positional accuracy of Google Earth's high-resolution imagery archive.
- 245 *Sensors* 8, 7973–7981.
- 246 4. Luo l., Xinyuan Wang X., Guo H. Lasaponara R, Shi P., Bachagha n., Yao y., Masini n., Chen f., JiW,
- 247 Cao H., Li C., and Ningke Hu. Google Earth as a Powerful Tool for Archaeological and Cultural Heritage
- 248 Applications: A Review. *Remote Sens.* 2018, 10(10), 1558;
- 249 5. Pankenier, D., 2013. *Astrology and Cosmology in Early China: Conforming Earth to Heaven*. Cambridge
- 250 University Press, Cambridge
- 251 6. Paludan. A (1981) *The Imperial Ming Tombs*. Yale University Press, Yale
- 252 7. Magli, G. (2018) *Astronomy and Feng Shui in the projects of the Tang, Ming and Qing royal mausoleums:*
- 253 *A satellite imagery approach*. *Archaeological Research in Asia*, at press
- 254 8. Wilkinson, E. (2000) *Chinese History: A Manual*. Harvard University Press, Cambridge (MA, USA).
- 255 9. Hongling Liu, Guanghong Zhou, Ronald Wennersten, Björn Frostell, *Analysis of sustainable urban*
- 256 *development approaches in China*, *Habitat International*, Volume 41, 2014, Pages 24-32,
- 257 10. Hald, M. (2009) *Sustainable Urban Development and the Chinese Eco-City Concepts, Strategies, Policies*
- 258 *and Assessments*. Nansen Institute, Lysaker, Norway.
- 259 11. Forte M., *Western Han landscape and remote sensing applications at Xi'an (China)*. In *Space, Time, Place:*
- 260 *Third International Conference on Remote Sensing in Archaeology*. Edited by Stefano Campana Maurizio
- 261 Forte Claudia Liuzza. *BAR International Series* 2118, 2010
- 262 12. Kenderdine, S., M. Forte and C. Camporesi 2012. *Rhizome of Western Han: an Omnispatial Theatre for*
- 263 *Archaeology*, in: Zhou, M., I. Romanowska, Z. Wu, P. Xu and P. Verhagen (eds.), *Revive the Past*.
- 264 *Computer Applications and Quantitative Methods in Archaeology (CAA)*. *Proceedings of the 39th*
- 265 *International Conference*, Beijing, April 12-16.. Pallas Publications, Amsterdam, pp. 141-158.
- 266 13. Weller, A.W. *Pyramids and the City: Urban Encroachment on Chinese Heritage in Xi'an* B.S.
- 267 *Architecture Thesis*, The Ohio State University, 2008