

Amkhoi Geopark: Geotourism and Socio-economic Development of the Rural Areas of Chaupahari Forest and Adjoining Area, Birbhum, West Bengal, India

Bikas Saha

Department of Geology, Durgapur Government College, J.N. Avenue, Durgapur, West Bengal, India.

ABSTRACT

Tourism that encourages or intensify the distinctive geological character of a place is called as geotourism. Interpretation, promotion and preservation of geological characters are the main focuses of the geotourism. Different abiotic ingredients, biotic components and cultures are involved in geotourism and as a result, this tourism redecorates its busyness. Geotourism represents the upgradation and shielding of the geoheritage sites by education and interpretation. This new form of tourism is environmentally futuristic. By popularizing tourist places into geosites, geotourism protects the geopark with the understanding of geologists. India is rich in georesources and geosites. It shows variety and uniqueness in terms of geological characteristics, types of rocks, fossils and landscapes but little attention has been given while acknowledging the geoparks and geoheritage sites. Geological sites with tourism potential and recreational potential will play important roles in socio-economic development. Angiosperm wood fossils have been discovered in the year 2006 from a tribal village, named Amkhoi, near Chaupahari forest, Illambazar of Birbhum district. After the inauguration of a fossil park here in Amkhoi in the year 2018, its success encourages its extension and further planning for geotourism. The Wood Fossil Park at Amkhoi attempts to integrate economic benefits for the local community by imparting education and awareness on the geo-site and hence is a good stride for attaining sustainability perspectives.

Keywords: Geopark; Geotourism, Socioeconomic Activity, Geo-conservation, Amkhoi Wood Fossil Park, Sustainable Tourism, Chaupahari Forest

1. Introduction

In the recent past, Prof. Thomas A Hose of department of Earth Science of the Bristol University invented the term “geotourism”. It was first coined in 1995. Hose defined geotourism as “to ensure the value and social preservation of geological and geomorphological sites and their materials and to provide interpretative facilities and services for the use of students, tourists and other casual recreationalists”. Interpretation, promotion and preservation are the main focuses of geotourism. As per Dowling and Newsome (2010) [1], it is an arrangement of tourism of natural areas where landscape and geology are the centre of attention. As time goes by geotourism and its definition evolved in 2012, an updated version of the definition of geotourism states that “geotourism is the providing of informative and service facilities for geosites and geomorphosites and their surrounding topography together through their allied in-situ and ex-situ artefacts, to build of constituency for their conservation by making appreciation, learning and research for current and future generations”.

Due to the involvement of different abiotic ingredients, biotic components and culture, geotourism redecorates its busyness. Geotourism represents the upgradation and shielding of the geoheritage sites by education and interpretation. It is appearing as a new form of tourism which is environmentally futuristic. By popularizing tourist places into geosites, geotourism protects the geopark with the understanding of geologists.

The word ‘fossil’ is Latin word ‘fossilis’, which means something obtained from digging. Fossils, the paleontological treasures, are preserved remains, impression or trace of organism that existed in past geological ages [2, 3]. They are generally found in sedimentary rocks. Fossilization is the process by which the remains of an organism gradually

transformed into fossil. Fossils are the data sources on paleo-environmental history. Fossils are the non-renewable earth heritages. They are imparting scientific knowledge on the climate of the past, past depositional environment of sediments, past geographical conditions, relative age determinations and past ecology [4]. Regarding the tourism potentiality of the fossil park, there are some research gaps that exist. This study aims to highlight the tourism potential in the youngest wood fossil park in India located at Amkhoi in West Bengal.

By involving many geologists, proprietors, social workers, tourism contributors, local people and private-public bodies, UNESCO started the concept of geoheritage park in the year 2001. By 2004, this beginning was converted into a program known as UNESCO Global Geoparks Network (GGN). Within the 44 member-country of UNESCO Global Geoparks Network (GGN), there are 161 UNESCO Global Geoparks. As a result of UNESCO initiative, newer and newer geosites are discovered worldwide due to the spreading appreciation of different processes of the earth as well as field surveying [5].

Fossil parks are distributed all over the world and they are acknowledged as the seeds of modern geotourism. Some of these fossil parks are achieving UNESCO’s world heritage sites title such as Australian Fossil Mammal Sites (Riversleigh/Naracoorte), Australia; Joggins Fossil Cliffs, Canada; Dinosaur Provincial Park, Canada; Chengjiang Fossil Site, China and Messel Pit Fossil Site, Germany. With their exceptional heritage and scientific values, these fossil parks have been complemented by UNESCO with its recognition under the Global GeoPark Network. For geotourism promotion and geoheritage conservation, these Global GeoPark Networks can play crucial roles [6]. There are numerous geoparks across the world which are primarily

*Corresponding author: sahabikas@gmail.com

based on fossils only. Geological Reserve of Haute Provence (France), Petrified Forest of Lesvos (Greece), Nature Park Terra Vita European Geopark (Germany), Abberley and Malvern Hills (UK), Geopark Schwabian Alb (Germany), Hateg Country Dinosaur Geopark (Romania) and Forest Fawr Geopark, Wales (UK) are among the popular geoparks where fossils are the main attraction [7].

India is rich in georesources and geosites but tiny consciousness has been rewarded while acknowledging the geoparks and geoheritage sites. From Archean to the Recent age, India shows variety and uniqueness in terms of geological characteristics, types of rocks, fossils and landscapes. But there are no ceremoniously accepted geoparks in India. Even, none of the geological sites have ever been nominated for World Heritage recognition. Geotourism is still at its juvenile stage in India despite the positive efforts of the Geological Survey of India which recognized 34 geological sites as National Geological Monuments for visitors among which there are seven fossil parks namely Siwalik Fossil Park, Himachal Pradesh; Marine Gondwana Fossil Park, Chhattisgarh; National Fossil Wood Park, Thiruvakkarai, Tamil Nadu; National Fossil Wood Park, Sathanur, Tamil Nadu; Akal Wood Fossil Park, Rajasthan; Jhamarkotra Stromatolite Park, Rajasthan; and Bhojunda

Stromatolite Park, Rajasthan. Apart from these, there are several fossil parks scattered in the different parts of the country viz, Indroda Dinosaur and Fossil Park, Gujarat; Dinosaur National Park Bagh, Madhya Pradesh; Mandla Plant Fossil Park, Madhya Pradesh; Ghughha National Fossil Park, Madhya Pradesh; Salkhan Fossil Park, Uttar Pradesh; Wadadham Fossil Park, Maharashtra; Dinosaur Fossil Park, Balasinor, Gujarat; Kutch Fossil Park, Gujarat; and Amkhoi Wood Fossil Park, West Bengal which could be classified based on four main fossil groups – Invertebrate fossil, vertebrate fossil, wood fossil and stromatolite fossil (Fig. 1) [2, 8]. There are only 3 – 4 wood fossil parks in India. One of them is the Amkhoi. Therefore, we ought to preserve the park for its uniqueness.

For the purpose of conservation of geosites, many researchers in India are trying to identify contemporary geoparks. Some researchers are trying to show the geotourism potential of Arunachal Pradesh. Ahluwalia [9] has focused on the geoheritage sites, geodiversity and eventuality of geoparks of India. Geotourism in the Kutch region of Gujarat is in the developing stage. Tirupati Eparchaeon Unconformity is a notified National Geo-Heritage Monument situated at Namalagundu of Andhra Pradesh [10].

Succession with Fossils	Type of Fossil	Age	Place	Reference
Tipam and Dupitila Groups of Assam	Wood Fossils	Middle–Late Miocene	Dhemaji and Lakhimpur districts of Assam	[11]
Barmer Hill Formation	wood-boring trace fossil Asthenopodichnium	Palaeocene	Barmer Basin on Lunu village on the Barmer– Bishala road	[12]
James Ross Island, Antarctic Peninsula	Fossil wood of the Winteraceae	Upper Cretaceous	James Ross Island, Antarctic Peninsula	[13]
Merae Formation, South-Central New Mexico, USA	Angiosperm Wood Fossil	Late Cretaceous	South-Central New Mexico, USA	[14]

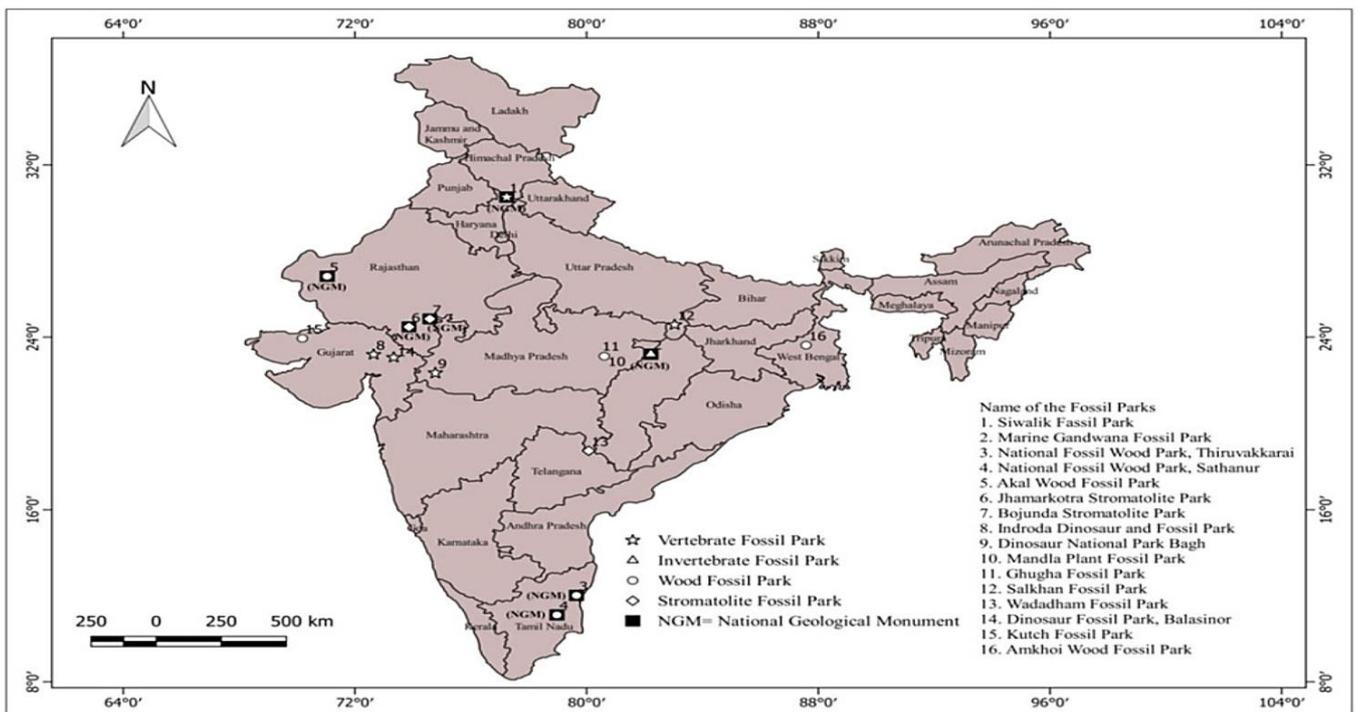


Fig. 1: Map of India showing National Geological Monuments [2, 8].

For socio-economic development, geological sites with tourism potential and recreational potential are playing important roles. Apart from promoting and conserving geoheritage sites, potent conversion of principles of geotourism outstandingly provides in the development of tourism as well as add economic value surrounding the geoheritage sites [15]. At present, geotourism is a new gesture to increase the bits of knowledge of tourists. And these knowledges are not only about a natural resource but also about the local culture and their preservation processes. In respect of commercial development in most of the countries, geotourism is still at an early stage. And in the development of geotourism of any geosites, geoparks are the pioneer. To explore different ingenious strategies and geomarketing, the involvement of local communities is very compelling. Moreover, to promote the socio-economic conditions of the local people and to increase the knowledge of geology among local bodies, we should set up geoparks. The flow of money is always towards geoparks side when tourists move to geoparks and tourists also exporting some agricultural products, local products and some cottage industry products with them. Geoparks have to support the establishment of local crafts and replicas, as well as support local products. Thus, visitors to geoparks can actually take with them, together with emotions and knowledge, manufactured goods.

About 18% of the world’s population, i.e., nearly about 1.3 billion people are living in India. Among these 1.3 billion, 65% of the population are living in rural areas [16]. So, for socio-economic development of the rural areas of India, geotourism sites in the rural area will play an important role. To convert any geoheritage sites to geopark, the collaborative endeavour is needed. Through recognizing, declaring,

promoting, preserving and branding, partners of the collaborative venture will help to promote the geoheritage site to geopark. Moreover, to establish geopark, we can use India’s vast geodiversity and extraordinary scenic beauty. Here in this article, we are presenting Amkhoi village as new possibility in terms of new geopark namely Amkhoi Wood Fossil park.

2. Study Area and Geology

Amkhoi fossil park, located at Chaupahari forest of Illambazar Forest range, Birbhum, is contemplated as one of the great geological treasures. Presence of the huge number of wood fossils demonstrated by a million years old sunken forests.

Amkhoi is that type of small village situated in the west side of West Bengal in the Chaupahari Forest near Illambazar where wood fossil has been discovered. Amkhoi Wood Fossil Park (23°37'25" N, 87°34'56" E) is situated about 20 kilometres from Bolpur town in Birbhum (Fig. 2) [3]. The park is about 10 hectares in size and is spread over villages like Amkhoi, Jambuni etc in the forest of Chaupahari at Illambazar. The park is maintained by the caretaker recruited by Forest Department, Govt. of West Bengal.

In the eastern part of the Indian subcontinent, the Bengal basin has been evolved. Towards west and north, this basin is bounded by Indian Shield and towards east, by Indo – Burman Ranges. Pericratonic Bengal, sedimentary basin deposited along the east coast margin of India [17]. It consists of easterly dipping shelf in the western and south western part of Bengal basin [18]. The famous Rarh Bengal is consisting of the Western lateritic part of West Bengal [19, 20].

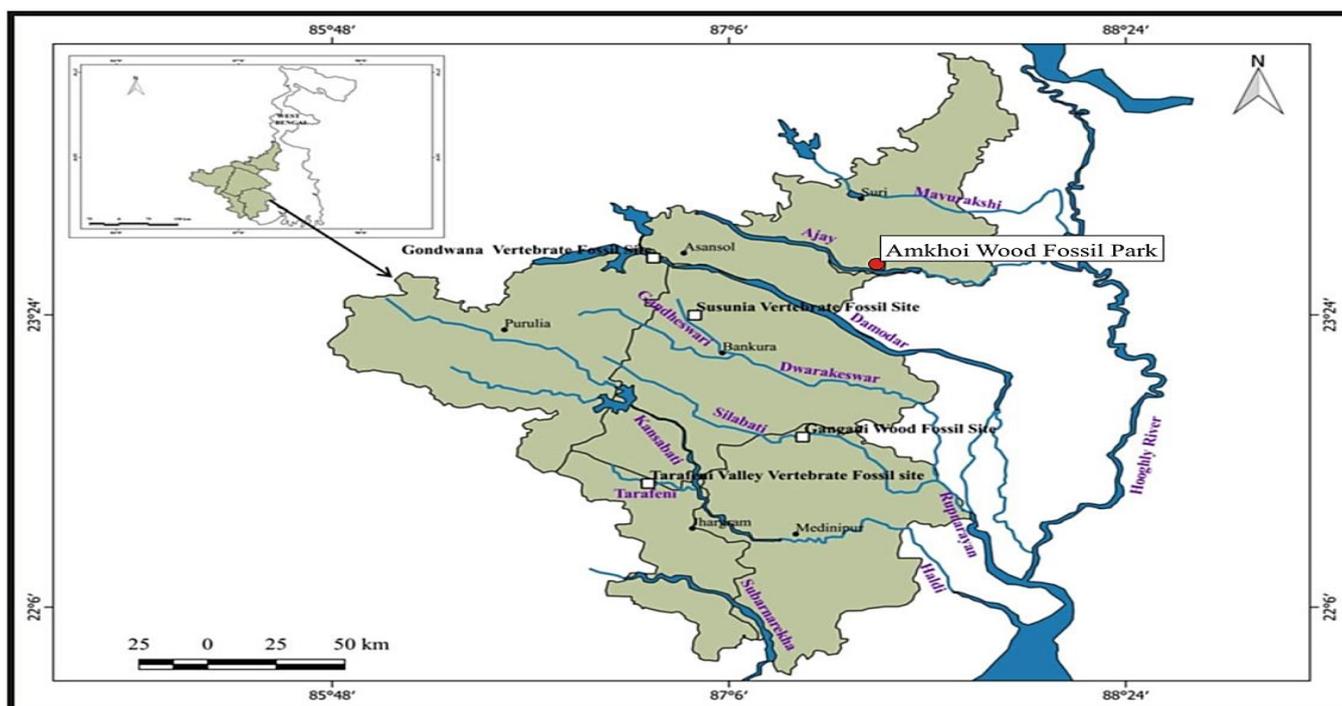


Fig. 2: Location map for Amkhoi Fossil Park (After Chakrabarty & Mandal, 2019) [3]

Geometry-wise Bengal basin is asymmetric with thinner, softly plunging sediment cover in both the western and northern parts of the basin [21, 22]. Sediment continues to accumulate in a basin-ward direction. Stratigraphy, sedimentation, tectonics and history of basin evolution in the different parts of the basin, over the entire belt show considerable heterogeneity.

Particularly, the stratigraphy in the different parts of the basin differs and as a result, the basin reflects contrasts both in pattern and history of deposition in the discrete basin [23].

These wood fossils of Amkhoi were preserved in the Late Cretaceous sedimentary succession, i.e., in Bolpur formation, uncovered in several individual patches in and around the western part of Bengal Basin (Fig. 3) [23]. These wood fossils were discovered at Amkhoi during the digging of a pond.

Concrete walls have been made around that pond (Fig. 4). Lithostratigraphically, these fossils are found in the cobble and pebble conglomerate strata.

3. Discussion

India is an exceptional country due to its fascinating geological history and it is transparent in its huge number of breathtaking and absorbing geological features dotted all over the subcontinent. Geological Survey of India (GSI) recognized some of these geological heritages as ‘National Geological Monuments’ (Fig. 1) [2 & 23]. GSI recognized these Monuments from the huge varieties of geosites like EcoGeo Monuments, Fossil Park, Geological Marvels, Rock Monuments, Stratigraphy Monuments, Stromatolite Park, Wood Fossil Park, present across the sub-continent.

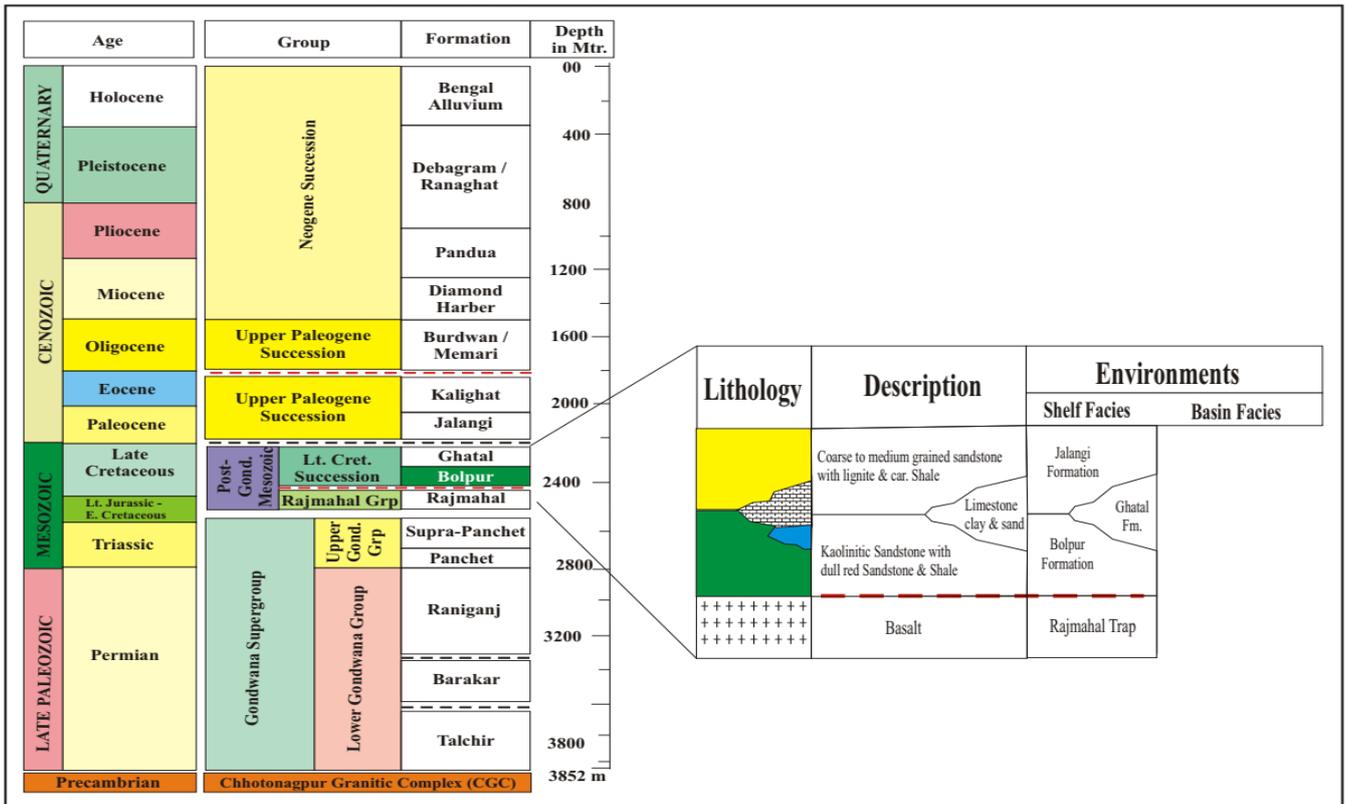


Fig. 3: Wood fossils of Amkhoi preserve in the Late Tertiary sedimentary succession of Bolpur Formation (After 2 & 23)



Fig. 4: Petrified wood or Wood Fossils discovered during digging of this pond at Amkhoi village during 2006.

Dating back to the early Permian onwards, as India was a part of Gondwana Land, India has a very rich deposit of fossil flora. Wood fossils and vertebrate fossils are also available across the parts of West Bengal [2].

The trees have been transformed into wood fossils during Late Miocene period here at Amkhoi. They have uprooted from the uphill of Rajmahal hills and Chotonagpur plateau due to force majeure and transported by intermittent floods and later on, under suitable conditions, they became petrified.

It is assumed that the trees were transported to the lower catchment of the drainage basin by intermittent floods after uprooted by natural calamities in the upper catchment area. Later on, these uprooted from upper catchments, and transported to the lower catchment's trees became petrified (Fig. 5). Depending upon the terrain characteristics, two major types



Fig. 5: Growth Rings is visible within the wood fossils of Amkhoi Fossil Park (Black Arrows).

of wood fossils generated – (i) silicified and (ii) calcified. But most of them transformed into silicified wood fossils (Fig. 6).

Amkhoi geoparks is now in the juvenile stage in terms of geotourism. During 2019, on an average, 300 to 350 persons per week used to visit Amkhoi geoparks. Now the number has increased significantly. Amkhoi geoparks are snuggled in the lap of a thick, dry, deciduous forest, namely Chaupahari Forest. The park is situated in the Amkhoi village within Chaupahari Forest, covering an area of about 10 hectares. The forest of Chaupahari consists of Mahua (*Madhuca longifolia*), along with some other flora which helps the indigenous people to live their life including honey from the forest (Fig. 7).



Fig. 6: Silicified (white arrow) as well as Charred (black arrow) Wood Fossil preserved in the area.

The fossil park is in the developing stage, still now, with the help of some group of local villagers. They are guarding their natural treasure by turning the king system. These local people also help the visitors with their quarries. Still, the fossils hunters and antiquethieves are robbing these treasure land and selling



Fig. 7: Floral assemblages of present Chaupahari Forest of Illambazar Forest Range, which are the supply line of different natural, forest products for the indigenous people of Amkhoi as well as Chupahari Forest.

these valuable fossils online for millions of dollars. But later on, when the local villagers realized the value of those natural treasures, they are taking care of the park. Local women set up a cafeteria, the sales centre here in the geopark. Due to the increasing number of visitors to geoparks, sell of different types of products also increasing day by day. Before starting the Amkhoi geoparks, villagers used to sell very few local, indigenous products like hand-held fans, Sital Pati Mat made of Date, Palm leaves, different sized containers made of bamboo, Mahua oil and Mahua fruits, and different drawing with natural colour. Even the indigenous people of Amkhoi and adjoining areas are using the natural colour extracted from the wood fossil (Fig. 8 & 9) to paint their houses (Fig. 10). So as a result, the villagers are noticing a slow but steady progress in their life and livelihood. Economically these villagers are more sound than pre-geopark times. Some resorts are constructed after the fossil park opened to the general public. Local people were talking about the economic developments of the area after the opening of the park. Indigenous people especially male persons were mostly addicted to country liquor. As a result, both the economy and their means of survival were unhealthy. But it has reduced remarkably since the establishment of the fossil park. So geotourism definitely improves the socio-economic conditions of the indigenous people of the Amkhoi village as well as the adjoining areas.

In the last two decades, globalization and the influence of the people of the west bring huge advancements in the thinking of the Indian people, thanks to the digital age and the recently launched Digital India programme. People have started to explore nature with their increasing economic affordability. People are taking an interest towards weekend outings and with increasing inclination towards weekend outings.



Fig. 8: Aesthetically pleasing, soft lustre and hues of different colours present within Petrified Wood.



Fig. 9: Hollow space (marked by white arrow), which was pocket of natural colour within the Wood Fossil.



Fig. 10: Indigenous people of Amkhoi and adjoining areas are using the natural colour extracted from the wood fossil to paint their houses.

At present, both the local public as well as the decision-makers in India are not realizing the importance of geoheritage sites properly. With the physical development of land surface and interventions for creating new landscapes, the landscape creating the menaces to geosites is growing day by day. INTACH (2016) [25] yielded a draft resolution as “The National Geological sites (conservation, protection and maintenance) Act. 2013” for adaptation to Govt. of India but is still to be made a law.

4. Conclusion

Indian sub-continent is enriched with extraordinary and rich geo-wealth. These multitudinous, elegant features, landforms and landscape of India bear huge knowledge-based, ethnic and societal desirability.

There are only seven heritage sites from India included in the list of World Heritage Sites in the last three decades. In UNESCO’s list of Global Geoparks Network (GGN), not a single geoparks from India will pop up [26].

Due to the socio-economic development of certain sectors of tourists, their behaviour as well as purchase habit has changed across the country. Therefore, some other forms of tourism like ecotourism, geo-tourism, agro-tourism, wildlife tourism, rural tourism, geo-ecotourism are explored by the government. By recognizing geotourism potential, the tourism potency of West Bengal will reinforce. By developing geotourism through pragmatic analysis and by applying geospatial techniques, geotourism will flourish more and the state will unearth more scope for its people. Hence geotourism will bring economic growth to the state.

Conservation of the paleontological resource is the primary aim of establishing any fossil park. Hence, to conserve this Amkhoi park, the authority should educate the local people as well as the visitors about these fossils and promote geotourism for the sustainable socio-economic development of the local community. As the Amkhoi wood fossil park is new, it can offer new employment opportunities as well as new economic activities to benefit the local people [26].

If local communities share fairly in the benefits that come out from geotourism opportunities, then only any geotourism venture should only be considered successful.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

The author acknowledges Mr. Ramprasad Bauri, Caretaker of the Amkhoi geopark, for providing various information about Amkhoi geopark and adjoining areas. The author express gratitude to Durgapur Govt. College for infrastructural facilities. This research did not receive any kind of grant from any funding agencies.

References

- [1] D. Newsome and R.K. Dowling, "Geotourism: The tourism of geology and landscape", Oxford: Goodfellow Publishers, 2010.
- [2] R. Mandal and P. Chakrabarty, "Tourism Potentials of Fossil Parks as Geoheritage Sites: A Study in Western and South Western Region of West Bengal, India" In: Jana, N.C. et al. (eds.), *Livelihood Enhancement through Agriculture, Tourism and Health*, Advances in Geographical and Environmental Sciences, pp. 247–260, 2022. https://doi.org/10.1007/978-981-16-7310-8_13
- [3] P. Chakrabarty and R. Mandal, "Geotourism development for fossil conservation: a study in amkhoi fossil park of west bengal in india", *GeoJournal of Tourism and Geosites*, vol. 27, no. 4, pp. 1418–1428, 2019. <https://doi.org/10.30892/gtg.27425-444>
- [4] R.S. Dietz, T.L. Pewl and M. Woodhoush, *Petrified wood (Araucarioxylon Arizonicum): proposed as Arizona's state fossil*. J Arizona-Nevada Acad Sci, vol. 22, no. 2, pp. 110, 1987.
- [5] P.E. Migon and P. Migon, "Promoting and interpreting geoheritage at the local level – bottom-up approach in the land of extinct volcanoes, Sudetes, SW Poland", *Geoheritage*, vol. 11, pp. 1227–1236, 2019. <https://doi.org/10.1007/s12371-019-00357-2>
- [6] G. Császár, M. Kázmér, B. Erdei and I. Magyar, *A possible Late Miocene fossil forest PaleoPark in Hungary*. Notebooks on Geology-Book 2009/03 (CG2009_B03), 2009, Chapter 11:130.
- [7] S. Turner, *Promoting UNESCO Global Geoparks for sustainable development in the Australian-Pacific region*. Alcheringa, Special Issue 1, 351–365, 2006. <https://doi.org/10.1080/03115510609506872>
- [8] Geological Survey of India (2017). <https://bhukosh.gsi.gov.in/Bhukosh/Geotourism.html>
- [9] A.D. Ahluwalia, "Indian geoheritage, geodiversity: Geosites and geoparks", *Current Science*, vol. 91, no. 10, pp. 1307, 2006.
- [10] P.R.C. Phani, "Geological excursion to Eparchaean unconformity at Namalagundu, Anantapur District, Andhra Pradesh, India", *e-Journal Earth Science India*, pp. 1–8, 2016. <https://www.researchgate.net/publication/297546285>.
- [11] R.C. Mehrotra, S.K. Bera, S.K. Basumatary and G. Srivastava, *Study of fossil wood from the Middle–Late Miocene sediments of Dhemaji and Lakhimpur districts of Assam, India and its palaeoecological and palaeophytogeographical implications*, *J. Earth Syst. Sci.*, vol. 120, no. 4, pp. 681–701, 2011.
- [12] S.C. Mathur, N.S. Shekhawat, S.L. Nama, C.P. Khichi, A. Soni, S. Mathur and V.S. Parihar, *The wood-boring trace fossil Asthenopodichnium from Palaeocene sediments of the Barmer Hill Formation, western Rajasthan, India*, *Current Science*, vol. 114, no. 7, 2018. doi: 10.18520/cs/v114/i07/1540-1544
- [13] Poole and J.E. Francis, *The First Record of Fossil Wood of Winteraceae from the Upper Cretaceous of Antarctica*, *Annals of Botany* 85, pp. 307–315, 2000. doi:10.1006/anbo.1999.1049.
- [14] E. Estrada-Ruiz, H.I. Martínez-Cabrera, SRS Cevallos-Ferriz, "Fossil woods from the Olmos Formation (late Campanianearly Maastrichtian), Coahuila, Mexico," *Am J Bot*, vol. 97, pp. 1179 – 1194, 2010.
- [15] R.K. Dowling, "Geotourism's global growth", *Geoheritage*, vol. 3, no. 1, pp. 1–13, 2011.
- [16] B.C. Prabhakar and K.N. Radhika, "Recognizing New Geoheritage Sites in Karnataka, India", *Geoheritage*, vol. 14, no. 3, 2022. <https://doi.org/10.1007/s12371-021-00626-z>
- [17] B. Prasad and B.S. Pundir, "Gondwana biostratigraphy and geology of West Bengal Basin and its correlation with adjoining Gondwana basins of India and western Bangladesh", *J. Earth Syst. Sci.*, vol. 129, no. 22, 2020. <https://doi.org/10.1007/s12040-019-1287-2>
- [18] A.B. Roy and A. Chatterjee, "Tectonic framework and evolutionary history of the Bengal Basin in the Indian subcontinent", *Current Science*, vol. 109, no.2, pp. 271–279.
- [19] S. Sengupta, "Geological framework of the Bhagirathi-Hooghly Basin", In: Bagchi K (ed) *The Bhagirathi-Hooghly Basin, Proceedings of Interdisciplinary Symposium*, University of Calcutta (Kolkata), pp. 3–8, 1972.
- [20] K. Bagchi and K.N. Mukherjee, "Diagnostic Survey of Rarh Bengal (Part II)", University of Calcutta, Calcutta, 1983.
- [21] Uddin and N. Lundberg, "Miocene sedimentation and subsidence during continent–continent collision, Bengal basin, Bangladesh", *Sediment. Geol.*, vol. 164, pp. 131–146, 2004.
- [22] J.R. Curray, F.J. Emmel and D.G. Moore, "The Bengal Fan: Morphology, Geometry, Stratigraphy, history and processes", *Mar. Pet. Geol.* vol. 19, pp. 1191–1223, 1993.
- [23] U. Ganguli, "A new lithostratigraphic unit at the Western fringe of West Bengal India", *India J Geol.*, vol. 67, no. 4, pp. 282–288, 1995.
- [24] Geological Survey of India (2017). <https://bhukosh.gsi.gov.in/Bhukosh/Geotourism.html>
- [25] INTACH (Indian National Trust for Art and Cultural Heritage: Natural Heritage Division) (2016) *A monograph on national geoheritage monuments of India* Web. <http://naturalheritage.intach.org/uploads/2017/11>.
- [26] UNESCO (2020) *International Geoscience and Geoparks Programme (IGGP) UNESCO Earth Sciences Web*: <http://www.unesco.org/new/en/naturalsciences/environment/earth-sciences/international-geoscience-and-geoparks-programme/>. Accessed 20 Oct 2020.