

**A GEOGRAPHICAL STUDY OF THE ANALYSIS OF THERMAL MEDICINE
PHYSICOCHEMICAL WATER QUALITY INDEX (WQI) AND THERAPEUTIC
PROPERTIES OF ECO-TOURISM SITES OF HOT SPRINGS IN THE WESTERN
SATPURA REGION OF NANDURBAR DISTRICT.**

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Abstract

The paper deals with the geographical study of the analysis of physicochemical parameters and therapeutic potentials of the hot springs in the Western Satpura region of Nandurbar District in the Tapi Valley region. Hot springs, geothermal springs, and hydrothermal springs are produced by the emergence of geothermally heated groundwater by circulation through faults to hot rock deep in the surface of the Earth's crust. The study focuses on key water quality indicators, including pH, temperature (Temp), pH (electrometric), electrical conductivity (EC), total dissolved solids (TDS), total hardness (TH), iron, nitrate (NO₃), fluoride, alkalinity (CaCO₃), chloride (Cl⁻), sulfates (SO₄), calcium, magnesium (Mg), and bacterial quality indicators are tested by using standard methods as prescribed by APHA 22nd Edition 2012, AWWA, Trivedy, and the Goel Methods in the National Accreditation Board Laboratory (NABL), Department of Ground Water Testing and Analysis, District Development Council of Nandurbar. The present research study is based on fieldwork and laboratory work based on surveying and empirical methodology. There are some scientific views and evidence that have proven the medicinal and mineral properties obtained from hot springs. These properties can cure or ease therapeutic effects in treating several diseases. Hence, a researcher has analyzed and proved the medical quality and its use in hot springs related to the medical and eco-tourism development of the Nandurbar district in Maharashtra. The findings offer valuable insights into the water quality trends and highlight potential tourism site concerns in the study area.

Keywords: Hot spring, Physico-chemical, Analysis, Parameters, health tourism, Medical Tourism, Tourism Development.

1. Introduction:-

India was one of the first countries to promote medical tourism. Currently, India is second only to Thailand in the number of medical tourists it has attracted since the early 1990s. India is an ideal place for medical tourism-related research. (Reddy, 2013). Since the end of the 20th century, health tourism has contributed to the economies of many countries, including India, Thailand, Malaysia, and Singapore, that increasingly offer health tourism services to foreign customers.

India is emerging as one of the favourite destinations for foreign travellers. Medical tourism, or health care tourism, is a fast-growing multibillion-dollar industry around the world. Medical tourism is often used synonymously with health tourism. Healthcare has

become a worldwide market, with emerging, developing, and developed nations challenging health tourists. (**Dawn Suman Kumar, Pal Swati, 2011**)

Medical tourism is related to the broader notion of health tourism, which, in some countries, has long-standing historical antecedents in spa towns, coastal localities, and other therapeutic landscapes. Health tourism is the organized travel outside one's local environment for the maintenance, enhancement, or restoration of an individual's well-being in mind and body. (**Neil Lunt, Richard Smith, Mark Exworthy, Stephen T. Green, Daniel Horsfall & Russell Mannion, 2010**)

Health tourism is from medical tourism, where health and wellness tourism indicates travel to spa resorts or for traditional and alternative therapies. Medical tourism encompasses primarily and predominantly biomedical procedures, combined with travel and tourism. (**Whittaker 2010, Connell 2006**).

Healthcare has become a worldwide market, with emerging, developing, and developed nations challenging health tourists. Medical tourism encompasses primarily and predominantly biomedical procedures, combined with travel and tourism. In recent times, the concept of medical tourism and eco-tourism has been developed a lot, and hence, medical tourism and eco-tourism sites of Maharashtra is among the best states in the country to pursue health tourism solutions.

Many more patients have to need post-operative care such as meditation, traditional homoeopathic spa, stress-relieving procedures, and other wellness treatments. So in recent times, the concept of medical tourism and eco-tourism has been developed a lot, and hence, medical tourism and eco-tourism sites are also developing in Maharashtra as well as India.

Over the last two decades, a considerable body of knowledge has been generated on the health benefits associated with specific geographical locations or regions, better described as therapeutic landscapes. (**Mihaela Serbulea, Unnikrishnan Payyappalliman, 2012**).

Maharashtra is among the best states in the country to pursue health tourism solutions. Maharashtra is one of the best wellness centers. Hot springs, or hydrological springs, are found in Khandesh as well as Maharashtra. Such wellness centers provide a meditational and Re-Life Ayurvedic medical and agro tourism facility in Lonavala, Khandala, Mahabaleshwar, Pune, Ganpatipule, Nashik, Vajreshwari, Igatpuri, Dhule, and Nandurbar.

The therapeutic medicinal eco-tourism sites of the Nandurbar district have provided one of the potential eco-tourism sites for the release of the physical and mental stress of tourists.

There are four hot springs in the Khandesh region (Jalgaon, Dhule, and Nandurbar districts): **Unapdev, Sunapdev, and Najhardev, Unapdev** 5 km north-west of Adavad from the first spur of the Satpuda region in the Chopda tehsils of Jalgaon district, the fourth Vadla in Shirpur in Dhule district Near the springs, the rocks are trapped, and the ground is hard and black.

Thermal springs in **Unapdev and Kundaleshwar** with different mineral contents have been used by people for bathing and health purposes since ancient times. The mineral water of these springs contains elements like sodium, potassium, calcium, and magnesium, as

well as chlorides, fluorides, sulfates, phosphates, and bicarbonates, which may be responsible for the cure of various skin and other diseases.

The present research paper identifies the strengths of medicinal ecotourism service providers and points out some problems that may reduce the growth opportunity of the industry. This paper focuses on the key issues and opportunities possessed by the regional medicinal ecotourism sector of Nandurbar District. The outcomes of this study could also be useful to prospective medical tourism centers in the Nandurbar District of the Khandesh region of Maharashtra.

2. Objectives:-

1. To examine the physiochemical and geothermal medicinal properties of hot springs in the Satpura mountain region.
2. To study the factors influencing medicinal health tourism development centers in Nandurbar District.
3. To study new scenarios and potentialities of medicinal and health ecotourism centers in Nandurbar District.
4. To identify responsible factors for potential tourist centers and to suggest a strategy for the development of concerned tourist places.

3. Research Methodology:-

The present research study is based on fieldwork and laboratory work based on surveying and empirical methodology. The research aims to determine the hot spring water of thermal medicine Physicochemical quality using the water quality index (WQI) method and geo-statistical analysis and to examine the importance and potential medicinal quality of hot springs and the therapeutic potential of tourism sites of hot springs in Nandurbar District.

The researcher collected hot spring sample water during a special visit dated September 13, 2021, from Unapdev of Shahada tehsil and Kundaleshwar of Taloda tehsil in Nandurbar district. The researcher recorded temperatures of 40⁰ C and 42⁰C (+5) while collecting water samples from hot springs in Nandurbar District.

The hot springs water sample has been tested on 10 parameters on APHA 22nd Edition 2012, AWWA, Trivedy, and the Goel Method dated on September 15, 2021.

This is a government-approved centre of the National Accreditation Board Laboratory (NABL), Department of Ground Water Testing and Analysis, District Development Council of Nandurbar, which has tested a hot spring for physical and chemical as well as biological parameters such as water temperature, transparency, turbidity, total dissolved solids, pH, dissolved oxygen, free carbon dioxide, and total hardness, chlorides, alkalinity, phosphate, and nitrates. Were analysed to determine whether a mediational ecotourism site should be developed or not. All parameters are within permissible limits. Such as DO, TDS, free CO₂, hardness, chlorides, alkalinity, phosphate, and nitrate, were estimated to hot spring water

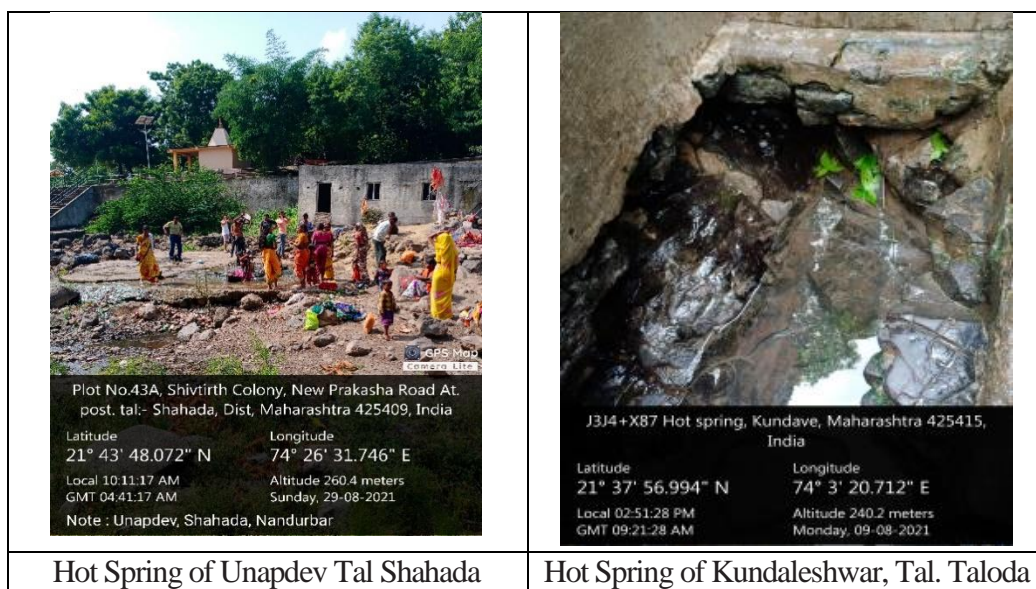
samples tested on 10 parameters in the laboratory by using standard methods as prescribed by APHA 22nd Edition 2012, AWWA, Trivedy, and the Goel Method.

4. Study region:-

The researcher has selected two sample locations of hot springs: Kundaleshwar in Taloda tehsil and Unapdev Shahada tehsil in Nandurbar District Foothill of Satpura mountain region of the Tapi Valley region.

Unapdev (Shahada tehsil) and Kundaleshwar (Taloda tehsil) hot springs are situated in the foothills, 200 to 300 meters above the mean sea level. The AMSL runs from the west to the east of the Satpura Mountain and is parallel to the Tapi River basin of the Khandesh region. The surrounding area of the hot spring location is highly dissected by swift streams originating on the south slope of the Satpura range and facing toward the Tapi River of the western Satpura Region of Nandurbar District.

Figure no. 1. Shown to Unapdev and Kundaleshwar are religious and meditational baths, health tourism, and eco-tourism centers in Nandurbar District. The Deccan traps formation with subsequent dykes and alluvial formation. The dyke has prominent, unflustered margins. In the southern part of the area examined around the thermal appearance, a thick mound of consolidated to semi-consolidated alluvium consisting of angular to sub-angular pieces of basalt and calcareous matter cemented in a clay matrix is seen here at the locations of Unapdev and Kundaleshwar of Nandurbar District.



Hot Spring Location	Height (M)	Latitude	Longitude
Kundaleshwar	240 Meter	21° 37' 56.994" N	74° 3' 20.712" E
Unapdev	264 Meter	21° 43' 48.072" N	74° 26' 31.746" E

6. Review of Literature:

National and International noteworthy of Hot Springs:

- 6.1 (Chandrasekharam, 2000)** has focused to the geothermal springs, Indian has 400 medium to high enthalpy geothermal springs, clustered in seven provinces shown are I) The Himalaya, II) Sohana, III) Cambay, IV) Son-Narmada-Tapi (SONATA) and V) the Godavari. Basically, The Satpura ranges are one of the dividers from the west-flowing Narmada and Tapi Rivers, which are widely viewed as occupying the structure of Horst and Graben (valley and range) implying that the Satpura is one of the horsts- a raised fault block bounded by normal faults.
- 6.2 (Reddy. D.V., Nagabhushanam.P. and Ramesh G., 2013)** Have studied to the geothermal springs in India located in different geological environments are broadly distributed into seven provinces: Himalaya, Sohana, Cambay, West Coast, Son–Narmada–Tapi (SONATA), Godavari and Mahanadi.
- 6.3 (Sonule B.B, Mukherji Dipti, 2015)** Illustrated that Hot springs attract the attention of researchers worldwide. Hot springs or hydrothermal springs are found in many parts of the world, and in India, the temperature of rocks increases with depth on geothermal gradient. The water is lightly sulphurous and has a varying temperature. It is also reported to cure skin diseases. There is a need for marketing of this hot spring tourism.
- 6.4 (W. Ramsay John, Pollen James, M. Campbell, 1880).** Has focused on the water is tasteless with a peculiar but not sulphurous smell and with no gas. It is believed to cure skin diseases.

Discussions:-

Since ancient times, hot springs have been used for medicinal purposes. There are some scientific views and evidence that has proven to the medicinal and minerals special definite properties obtained from hot springs, these properties that can cure or ease to therapeutic effects for treating a number of diseases.

The Natural Hot Water Springs (Also called as ‘Garam Kund’ locally). This location are created through volcanic eruptions in the thousands of years ago are now the green belt and villages with hot springs, still sacred as per Hindu mythology and solution to multiple skin diseases. Rocky springs / kund water is actually a mixture of natural minerals and sulfur which when is geothermal heated is thrown upward towards the surface is called a hot spring.

The word ‘Unap’ means hot water and in Khandesh Ahirani language, ‘Vuna Dev’ stands for the almighty that generated this fountain. It has a permanent natural hot water source, and it flows throughout the year from a structure in the shape of a cow’s mouth, which always flows even in hot summer. Hence this is known as Kundaleshwar in Taloda Tehsil and Anther is Unapdev in Shahada Tehsil. This is a permanent natural hot water source of Nandurbar District.

India is in an advantageous position to tap the global opportunities in the medical tourism sector. The term of “**medical tourism**” was coined by travel agencies and the mass media to describe the rapidly growing practice of traveling across international borders to obtain hi-tech medical care. India is one of the homes of doctors. Tourism helps in curing health related ailments and diseases. (Dawn Suman Kumar, Pal Swati, 2011)

Researcher has analyzed Chemical parameter and compared with provided by WHO permissible limit. The water quality of Kundaleshwar and Unapdev was assessed for Physico- chemical biological researcher has collect 40 and 42⁰C (+ 5⁰C) temperature recorded at the time of Sample Collection of Kundaleshwar and Unapdev, by using Thermometer. The pH recorded at Kundaleshwar and Unapdev was alkaline water (pH>7) 7.8 and 9.4 respectively.

Table No. Chemical & Bacteriological Testing Report of Hot Springs					
Sr. No	Chemical Testing Report				Kundaleshwar
	Hot Spring	BIS 10500:2015		Unapdev	
	Parameter	Desirable	Permissible		
	Sample Collection Date			13/09/2021	13/09/2021
	Date of Sample Assessment			13/09/2021	13/09/2021
	Name of Sample Collection Pot			Lab. Glass Bottle 1 Liter	Lab. Glass Bottle 1 Liter
1	Temperature (0 ⁰ C) Sample Collection Time			42 ⁰ C	40 ⁰ C
2	Colour			Clear	Clear
3	Odour			Odour free	Odour free
4	pH (Electrometric)	6.5- 8.5	--	9.4	7.8
5	Electrical Conductivity (µS/cm) (mg/L) (EC)			278 mg/L	263 mg/L
6	Total Dissolved Solid (mg/L)	500	2000	177 mg/L	168 mg/L
7	Total Hardness (mg/L)	300	600	36 (mg/L)	116 (mg/L)
8	Iron (mg/L)	1		0.01	0.01
9	Nitrate (NO ₃) (mg/L)	45		0.01	0.01
10	Fluoride (mg/L)	1	1.5	0.01	0.01
11	Turbidity (NTU)	0	10	0.0	0.0
12	Alkalinity CaCO ₃ (mg/L)	200	600	20	30
13	Chloride (Cl ⁻) (mg/L)	250	1000	140	50
14	Sulphates Sulfate (SO ₄) (mg/L)	200	400	9	8
15	Calcium	75	200	--	--
16	Magnesium	30	100	--	--
Bacteriological Sample Report					

	Bacterial Test	Desirable	Permissible	Good or Bad for Consumption	
17	Residual Chlorine (mg/L) (ppm)			0.0	0.0
18	E- Coli MPN/100 ml	0	0	Good	Poor (Bad)
19	Coli Form MPN/100 ml	0	10	Good	Poor (Bad)
	Result			Drinkable	Not Drinkable
Report of (National Accreditation Board Laboratory), Department Of Ground Water Testing and Analysis, District Development Council of Nandurbar. Dated 13/09/2021					

The chemical characteristics of thermal water discharge from Unapdev (Dara) hot spring is sodium Chloride type. The source of the saline component (Cl) is attributed to ancient formation waters trapped in the geological formation, of magmatic or hydrothermal fluids. The percentage of total cation (going down) generally, metals form cations and anion going up generally, non – metals form anions (Na-HCO₃) is found to be a good indicator of the hotness of water discharging from the spring. The concentration of SO₄ ions in hot spring waters is small. This unusual concentration reveals that the origin of SO₄ ions in the hot spring water is related to pyrite (FeS₂) minerals in the rock formation.

The hot water springs in Unapdev are said to be rich in sulphur contents; which makes them ideal for medicinal usage. Hence people from many parts of India, visit this place to bathe in these water springs. These hot water springs are believed of curing out all the skin ailments.

Researcher has identify the hot springs water quality assessment and monitoring that occur in study areas, and to provide the accumulated information and assessments, used to evaluate alternatives and make necessary resource management decisions.

Researcher has collected a hot spring Sample data and analyse through National Accreditation Board Laboratory, Department Of Ground Water Testing and Analysis (District Development Council of Nandurbar.) Department of Ground Water Testing and Analysis department has reported Chemical and Bacteriological sample report of the Unapdev and Kundaleshwar of Nandurbar District. The hot water of these springs contains elements like sodium, potassium, calcium, magnesium as chlorides, fluorides, sulphates, phosphates and bicarbonates which may be responsible for cure of various diseases. pH value of Unapdev is 9.4 and Kundaleshwar are 7.4 pH, Temperature is 42⁰C & 40⁰C (+ -5), Electrical Conductivity (μS/cm) (mg/L) (EC) 278 mg/L and 263 mg/L, Total Dissolved Solid (mg/L) 177 & 168 mg/L, Total Hardness 36 and 116 (mg/L) Iron (mg/L) is a 0.01, Nitrate (NO₃) (mg/L) 0.01, Fluoride (mg/L) 0.01, Turbidity (NTU) is Nil, Alkalinity CaCO₃ (mg/L) 20 & 30, Chloride (Cl) (mg/L) 140 & 50, Sulphates Sulfate (SO₄) (mg/L) 9 & 8 Unapdev and Kundaleshwar are respectively.

7. Conclusions and Suggestions :-

The present study is aimed at understanding the source of hot spring water, High concentrations of TDS may affect taste adversely. A chemical analysis of Unapdev and

Kundaleshwar hot spring water source shows on the table No 1 was found Chemical and Bacterial test found in laboratory testing.

The overall process of assessment of the physical, chemical and biological testing of water in relation to therapeutic quality of hot springs, sustainability of eco-tourism development site, durability of water hardness, TDS and overall water quality of human consumptions, effects and intended uses, particularly uses which may affect human health and the health of the aquatic system itself. The outcomes of this study could also be useful to prospective medical tourists. As per the view of researcher, this is the only study on medical tourism development.

This study examined the thermal and chemical features of two hot springs located in the foothill of Satpura region of Nandurbar District. There are some scientific views and evidence that has proven to the medicinal and minerals special definite properties obtained from hot springs, these properties that can cure or ease to repair skincare diseases. Such medicinal properties are available in the Unapdev and Kundaleshwar hot springs; that is Unapdev and Kundaleshwar is one of the best geographical potential tourist destinations in the study region. But this tourist destination is under the jurisdiction of the Forest Department of Shahada. Therefore, the Government of Maharashtra and District Development Council of Nandurbar have certain limits for the development of tourist destinations. For this, the Forest Department Shahada should take the initiative to create an attractive fully facilitated Medicare center and Eco-Tourist center in the Nandurbar district. as soon as possible and provide necessary facilities to the tourists at Unapdev, thousands of domestic tourists have come from Maharashtra as well as Madhya Pradesh, and Gujarat state and national and international tourists, hence Unapdev hot spring is one of the emerging eco-tourism and Medicare tourist centers of Shahada tehsil in Nandurbar District.

Unapdev tourist place newly formed tourist destination of the Shahada tehsil, but the Forest Department Shahada should take the initiative to create an attractive fully facilitated Medicare center and Eco-Tourist center in the Nandurbar district. As soon as possible and provide necessary facilities to the tourists at Unapdev.

The researcher has made some suggestions. They are as follows:

- A. To establish scientific concealing center for giving information about hot spring.
- B. To develop eco-tourism site for the recreational purpose.
- C. Need to proper maintain hot springs sources of the study region.
- D. To plan to maintain the Eco Tourist centre
- E. To stop the pollution of spring water.

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