WORLD GEOGRAPHY

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CHAPTER 1

INTRODUCTION TO POLITICAL GEOGRAPHY

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ABSTRACT:

The major subfields of human geography are recognized by the adjectives that come before them, which are, in alphabetical order, cultural, economic, political, and social geographies. Each of these occupations has given rise to a unique set of textbooks that offer diverse spatial perspectives on each of these human endeavors. Everything seems orderly and straightforward, as it should be. But because so many diverse people typically members of an older generation who are wealthy, white, and male are involved in creating our society, especially the world of information, it is never neat and orderly. Political geography, in particular, differs significantly from its sister adjectival geographies. Cultural, economic, and social geo- graphies are relatively recent arrivals; most of them emerged in the latter part of the 20th century. But political geography was a subfield that existed at the time geography was created as a university science in the late nineteenth century, a time of imperial conflict. As a result, it has a history that is as old as its field, which sets it apart from other branches of human geography.

KEYWORDS:

Alternative State, Dormant Backwater, Imperial Conflict, Presumed Objectivities, Unification Germany.

INTRODUCTION

Understanding our past does more than help us avoid repeating our mistakes. Insights into what is and is not conceivable in political geography are provided by the experience obtained through exploring the field's past. What kind of political geography knowledge is it feasible to develop after exposing the falsity of earlier "political certainties" and "presumed objectivities"? To this question, there have been three main responses. Given the "bad experiences" of political geography, the simplest solution has been to steer clear of political dispute and create political geography that consists of a basic list of only tangentially related issues, a description of things "political" using maps [1]. This approach's absence of theory gave it the appearance of objectivity or neutrality, but the result was a mediocre subdiscipline. Another response to the lack of coherence has been to create a more theoretically sound.

Political geography reached the pinnacle of its influence before the other subdisciplines began to take off substantially. This has both good and bad aspects. Because political geography became entangled with the political upheavals that gripped Europe in the first half of the 20th century, it is the latter. In short, some aspects of political geography became associated with some of the less honorable political groups of the time, including Nazi politics, in a minor but significant way. As a result, political geography's "biography" differs greatly from that of the rest of geography. This is now viewed positively since it brings to light the current problem of connecting geographic knowledge to policymaking.

Prologue: Events in the history and development of a field of study that influenced political geography. This required selecting a theory from the broad social science toolset and reinterpreting political geography along new axes. Building on the diversity that was alluded to in the first approach, a third viewpoint has been established using more complex ideas of

political power and location. This is accomplished by selecting a social theory that values diversity and is frequently referred to as "postmodern."

We adhere to the middle ground outlined above in this text: To give political geography's subject matter significant consistency, a theoretically informed political geography is proposed. The theory selected to support the discipline is world-systems analysis. This is a practical decision based on years of political geography experience [2]. Simply put, we have discovered that this particular theory is extremely pertinent to the ongoing issues of political geography in "global times" because of the way it specifically treats time, place, and power relations. Additionally, we think that this strategy provides the most direct answer to the relevancy query. The welfare of the vast majority of people who live in poverty around the world is the main concern of world-systems analysis. It strives to be a deeply democratic political system for modern times. The text's first chapter introduces world-systems analysis as a theoretical framework and lays out the fundamental ideas for interpreting contemporary political geography. This top theory selection, nevertheless, does not exclude adopting significant concepts from other theories that have helped political geography become such a lively, modern sub-discipline in recent years. We continue to take an eclectic approach, but since we must start someplace, we have chosen to use the coherent story of world-systems analysis as that place. Let's continue with how we move from the initial and early "dark" political landscapes to today's more emancipatory offerings, but more on that later where you may get more information to delve deeper into the topic. We believe you'll find the story to be incredibly engaging.

Ratzel's organism: advancing an alternative state

New fields were developed as a result of the addition of research to traditional teaching duties in the German university system during the nineteenth century. Geography entered this process rather late, with geography departments becoming widely founded only after the unification of Germany in 1871. In actuality, the state funded geography as a field hence, the state evolved as one of geography's primary research topics. When Friedrich Ratzel's Politische Geographie was published in 1897, this was strengthened, and Ratzel came to be known as the "father of political geography."

Ratzel started his studies as a life sciences major, and the positive reception of Darwin's ideas in the German academic community had a significant impact on him. He acquired a worldview that was influenced by the lessons he learned from Darwin when he held a newly created chair in geography. Even though he authored Politische Geographie toward the end of his life, the evolutionary approach had a lasting impression on him. The Second Reich's unification of Germany was still recent at this point, and the forces pushing for great power status were growing stronger [3]. Its supporters included Ratzel. Thus, the issue of state rivalry was one of his primary political concerns, which he interpreted as the war for territory via the lens of political geography. What kind of state theory would you require to establish a vibrant new nation-state? Ratzel used the writings of another German scientist and the father of ecology, Ernest Haeckel, to find the solution in his Darwinian viewpoint.

The same is true of nations as states in the global political environment; all living things (as species) need to establish a niche within the natural environment to survive and develop. The same principles that apply to ecological also apply to political geography: the fittest will prevail. The 'organic theory of the state', which serves as a blueprint for state growth, is the outcome of this method of thought.

Seven "laws of the spatial growth of states" were outlined by Ratzel. The middle "law" in "Life and Times of a Subdiscipline" is crucial: The boundary participates in all of the transformations

of the state's organism and is the peripheral organ of the state, carrying both its expansion and its fortification. In essence, he contends that states expand naturally as society's culture gets more "advanced." States can never simply be defined by lines because of this; instead, he envisions a world with shifting borders. In a system of "territorial annexations and amalgamations," expanding states enclose "politically valuable locations." Therefore, a state's territory is never more than a "transitional stage of rest for the fundamentally mobile organism up until the moment at which cultural growth comes to a halt [4]. He views this as an example of the "land-greed" that has characterised all conquering states throughout history. He recognizes two scenarios for this process in his own times.

First, as a natural representation of their cultural superiority, European states naturally grow through colonial conquest at the expense of 'less-civilized' peoples. Second, Prussia and Piedmont merged with nearby lesser states to become equal with existing great states like France and Austria in "crowded Europe," where the unifications of Germany and Italy are seen as the creation of original small states. In this sense, the world political map remains dynamic to accommodate the emergence of new powerful powers, according to Ratzel in the late nineteenth century. It is difficult to think of another "scientific" idea that is more suited to the requirements of a specific state. A latecomer to colonial development, the newly united German Second Reich was hemmed in by older great states in Europe (Russia, Austria, and France) and was only just starting to carve out its empire outside of Europe. Of course, looking back, we can see that Germany's defeat in the First World War was a direct result of this organism metaphor for expansion. Later in the 20th century, international peace regimes were created (for instance, through the United Nations) based on sovereignty and the inviolability of state borders, making the world political map more stable than Ratzel had envisioned it to be. Despite the fact that the number of states significantly increased in the second half of the 20th century as a result of the decolonization of Western empires and the dissolution of communist states (such as the USSR, Yugoslavia, and Czechoslovakia), all of the new states that were created have maintained previous colonial or provincial borders. The lone exception occurred in 2011 with the founding of South Sudan. In other words, boundaries have been strictly upheld; the norm now is new states, but not new borders. Ratzel's thesis seems so terrifying to us now since this is the exact opposite of Ratzel's condition as organism [5].

Mackinder's heartland: preserving an antiquated empire and more

In addition to being a British politician and Member of Parliament from 1910 to 1918, Sir Halford Mackinder is often regarded as the "father of British geography" because of his ardent advocacy for the inclusion of geography into British colleges in imitation of German universities. He was a theoretical and applied political geographer, just like Ratzel, and he thought about the threats that new rising governments posed to the British Empire [6]. However, his concerns were the opposite of Ratzel's. Despite owning the biggest empire ever, Mackinder believed he had found potential, catastrophic flaws in Britain's geography. The concepts he created around this worry were much more widely discussed than Ratzel's political geography, and as a result of their greater longevity, they ultimately became even more worrisome: in the nuclear standoff that would become known as the Cold War, Mackinder's ideas from the first half of the 20th century were revived to justify the Western nuclear arsenal accumulated to make up for the USSR's alleged geographical strategic superiority. This is a disturbing account of how, when necessary, a straightforward geographic pattern may traverse entirely different political situations.

1. Initially, a global model of political order based on the distribution of land and water in relation to current transportation technology was put forth by Mackinder.

2. His perspective on the world was centered on the geopolitical rivalries over control of Eurasia throughout history.
3. Mackinder described a "pivot area" as a "natural seat of power" that included northern Siberia to the north of the Three northern Asian Mountains and was out of the reach of naval power, or in other words, beyond the military reach of Britain and its so-called "gunboat diplomacy."

By the beginning of the 20th century, this situation was important since the advent of the railways allowed for the full mobilization of land-based power. Thus, the balance between sea power and land power was significantly shifting in favor of the latter: intrusions by governments that controlled the pivot area into zones controlled by naval powers would thus become substantially simpler than incursions by naval powers into the pivot area. The path to global dominance thus becomes available for the political power that controls the pivot region (see Figure P.1a). When he first proposed these ideas, the Russians were the current occupants of that region, but in his renowned, later modification (Mackinder 1919), he grew concerned about a German-Russian alliance controlling a somewhat bigger region he termed the "heartland." The 'heartland thesis' is what has endured for such a surprisingly long time [7].

Therefore, Mackinder's political geography prescription for preserving the British Empire was to simply stop an alliance of German and Russian land power. It is odd that Mackinder's theory should have been regarded as having any relevance after 1945 given that it was initially centered on the global expansion of railways and ignored airpower. However, the USSR's victory in the Second World War and the ensuing spread of its influence into the heartland led to the kind of power structure Mackinder had feared. The start of the Cold War gave Mackinder's model, which was initially intended to be a survival strategy for the British Empire, a new context and ironically allowed it to become a significant strategic tool for many goals.

The US's concern for preserving a Cold War balance of power against the USSR was one of the new ends. Thus, for US military strategic planners, Mackinder became a "Cold War prophet" following his passing in 1947. A straightforward geo-graphical pattern persisted as a justification for storing even more nuclear weapons to confront the USSR's "natural seat of power," to use Mackinder's original phrase. Military infrastructure had advanced from railway mobilization to intercontinental ballistic missiles. The assertion that Sir Halford Mackinder was the most influential geographer of the 20th century is supported by the use of his arguments to encourage a nuclear arms race [8].

DISCUSSION

Leading political geographers from the UK and the US, including Mackinder and Isaiah Bowman, served as advisors at the 1919 Peace Conference of Versailles, where Germany was punished economically for losing the First World War by having its colonies taken away. German geographers were underrepresented at Versailles, but they played a significant role in the country's subsequent public discussion. A veteran soldier named Karl Haushofer was the leading geographer in the drive to undo the "unfair peace," as he saw it. From his headquarters in Munich, he developed the discipline of geopolitics as a body of applied knowledge with the goal of regaining Germany's prominence on the world stage. A specialized periodical called Zeitschrift für Geopolitik, which he published between 1924 and 1944, served as the major vehicle for achieving this goal. Mackinder was acknowledged by Haushofer as a major influence. In the Zeitschrift, ideas and conjectures regarding Germany's potential allies and enemies in Europe were motivated by Mackinder's heartland thesis. Additionally, Haushofer connected this to lebensraum, which was taken from Ratzel's organism model and once more

supported European territorial expansion. In addition, through fostering and expanding German interest in the colonial world, he added his own unique political geography contribution. Germany entered the colonial world at the end of the nineteenth century, but it was a latecomer, and it was a chaotic jumble of territory [9]. This was a reflection of the development of European imperialism, which was originally led by Spain and Portugal and then by France, England, and the Dutch. There was no overarching organization, simply historical accidents caused by rivalries and fights between states.

Surely the spatial arrangement of imperial political geography could be more logical? Life and times of a sub-discipline Haushofer reasoned that this might be accomplished by eradicating the empires of the previous imperialists, mainly Britain and France, and reconfiguring space into fresh panregions. These would be enormous intercontinental "vertical" zones that were dominated by one powerful state (north to south; see. The Americas as envisioned under the Monroe Doctrine, whereby the US asserted a form of "military protectorate" of the Latin American governments when they attained independence from Spain and Portugal in the eighteenth century, served as the prototypical example. Despite not creating new colonies, the US expanded to become the de facto dominant state in the Americas. The Americas were joined in pan-region discussions by either two or three other pan-regions [10]. These were an Asia-Pacific pan-region dominated by Japan and a Eur-African pan-region dominated by Germany, with a middle Russo-Indian pan-region dominated by the USSR occasionally (depending on political agreements between these two) (O'Loughlin and Van der Wusten 1990). Such pan-regions were justified geographically since they crossed all "horizontal" (east-west) environmental zones, encompassing all of Earth's natural resources inside each pan-region. The fundamental Days in the Life of a Subdiscipline

It was said that resource wars would not occur since every pan-region could be economically self-sufficient: pan-regions were a recipe for world peace. Of course, the alternative explanation was that, in order to regain world power status following the failure of the Treaty of Versailles, Germany was buying off the US, Japan, and potentially even the USSR. In reality, Haushofer's geopolitik is not remembered for its megaimperialist paradigm in particular. Naturally, Haushofer's theories found particular application in Hitler's Third Reich, notably the idea of lebensraum as Germany and Japan began to extend their borders in the late 1930s. Haushofer rose to prominence during World War II, especially in the USA, as "Hitler's geographer," preparing to destroy the West American geographers made an effort to set their' scientific' political geography apart from Haushofer's geopolitik, particularly Bowman. But the harm had already been done: Haushofer left behind a significant political geography legacy. The term "political geography" was outlawed in the USSR; as late as 1983, when the International Geographical Union established a grouping of academic political geographers, it had to go by the name "Commission on the World Political Map" (rather than "on Political Geography" per se) in order to be approved by all delegates. Language restrictions were less severe in the West, as seen by the absence of any books using the word "geopolitics" in the title between 1945 and 1975 But can political geography exist without taking into account other countries?

Hartshorne's functionalism: building a dead zone

The USA after World War II, a region of the West where political geography continued to evolve, appears to be the 'yes' response to the aforementioned question. There were instances of the highly male "international political geographies," which we have just encountered, continuing in America. For instance, Van Valkenburg put forth a cycle theory of the state based on physical geography models of river valley erosion processes. According to this theory, states should go through phases of childhood, adolescence, maturity, and old age in that order. These

concepts were very evocative of Ratzel; naturally, in this instance, the US was seen as "mature," whereas European states were viewed as being in their senior years. Additionally, George Renner proposed during World War II a highly Ratzel-like redrew of the European map in which smaller governments would be absorbed by larger ones (both the Netherlands and Belgium were to disappear), leading to the 'great map controversy [11].

And that is the key: in a new world where a United Nations was being established precisely to guarantee respect for sovereign boundaries, top-down, macho political geography was no longer acceptable. As was already mentioned, Mackinder continues to be significant as a Cold War prophet, but American geographers have developed a new, respectable political geography that is mostly devoid of international politics and occasionally even politics itself. Respectability seems to be sacrificed by throwing out the baby with the bathwater. The main architect of this reputable political geography was Richard Hartshorne. Ironically, it was his seminal book The Nature of Geography (Hartshorne 1939) that largely introduced German geographic concepts to the field of geography. Later, he played the exact opposite function in the field of political geography, purging German concepts. In order to accomplish this, he used functionalism. This method was widely used in the social sciences in the 1950s and provided study goals for figuring out how complex social units can remain stable through the way they function. Just such a research program for political geography was established by Hartshorne in 1950 in the shape of a functional method for examining the state.

The territorial state was used as Hartshorne's research unit, and it was thought that its spatial integration constituted "the primary function of any state." Two types of forces contributed to a state's success: centrifugal forces tore the state apart while centripetal forces held it together [12]. A state's long-term sustainability is determined by how these factors are balanced. For instance, severe racial or religious divisions may be the key factor in the demise of a state, but this Life and times of a sub-discipline 6 can be mitigated by a potent 'state-idea' such as a unifying nationalism that encourages territorial integration. In this way, Hartshorne offered a straightforward model for evaluating the balance of forces in each condition individually. Stephen Jones developed this strategy further as a "unified field theory" that defined the construction of a successful state as a series of five steps in which centripetal forces prevail (if centrifugal forces "win," the chain is broken, and the state-making process fails). These contributions from the early 1950s would dominate the field of political geography for more than 20 years; they were reprinted in student readers in the 1960s and they continued to have an impact on textbooks well into the 1970s Functionalism's fundamental flaw is its tendency to marginalize dispute by accepting the status quo as a given, which is a conservative bias. Political geography must take this very seriously, according to Burghardt. Treating states separately ignores the larger power systems that govern all states. Although Hartshorne acknowledges that states have external interactions, he reduces these to the territorial and strategic problems that each state faces. Additionally, he specifically ignores "vertical" (social) differences within states in favor of "horizontal" (spatial) differences, which eliminates the majority of domestic politics that take place in all states throughout the world. This is the main justification for the dismissal of this early post-Second World War American-led sub-discipline as "apolitical political geography." The functionalist approach caused a problem for the field because individuals who are interested in political geography are probably also interested in politics. The unsavory past was successfully removed from study agendas thanks to its apolitical inclinations, but at the cost of producing a politically sterile subject [13]. As a result, political geography immediately lagged behind other subfields of geography in both study and instruction. Key texts of the 'new geography' that emerged in the 1960s conspicuously omit political geography: Classic Location Analysis in Human Geography ignores the field, and the influential Models in Geography does not include a chapter on it. Political geography was

everything but interesting at a time when geography was once again becoming thrilling, thus it should come as no surprise that Brian Berry, the father of the new geography, publicly described it as a "moribund backwater" in 1969 [14].

CONCLUSION

There was, in essence, only one path out of the dormant backwater: up, since it is unimaginable that human geography could flourish and prosper without a political sub-discipline. It took a variety of shapes. Although they gave functionalism lip respect in the beginning, authors did find interesting topics for their textbooks that weren't unduly confined by apolitical dictates. However, by ignoring the functional structure, books lost coherence and were reduced to being lists of various topics with no discernible connections between them. This opened the door for willful unequal growth across topics. For instance, the geographical study of elections has become a significant development topic in the new quantitative geography since voting statistics in areal units are publicly accessible and lend themselves to statistical analysis. There were, of course, Hartshorne Ian echoes from the past asserting that such research was 'social geography' rather than a component of political geography but this new work was more generally accepted as a political geography contribution to understanding domestic politics within states. The actual problem was that the nascent political geography treated themes in an uneven manner, which in turn revealed the subdiscipline's lack of theoretical sophistication. Simply put, there didn't seem to be any useful standards for creating new political geography study topics without Hartshorne's functionalism.

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CHAPTER 2

A CASE STUDY ON WATERFALLS AND HEALTH TOURISM IN INDIA

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ABSTRACT:

Most people agree that the waterfall is more of an attraction than a place to go. This essay explores the essence of waterfalls using a theoretical framework that was created using survey and interview techniques. The primary emphasis is on the SWOT analysis of waterfalls, a relatively new idea in the research domain. The tiniest district of Karnataka, known as the Scotland of South India, Kodagu, has the potential to use its waterfalls as the core of a health tourism, Ayurvedic, and rejuvenation industry. The idea of monsoon tourism can be successfully used as a tactical plan to take use of Kodagu's unique resources. The main focus of the study is a brief overview of the main waterfalls, the topographical aspects, and diverse applications. Tourism is travel for pleasure, business, and amusement. People who "travel to and stay in places outside their usual environment for more than 24 hours and not more than one consecutive year for leisure, business, and other purposes not related to the exercise of an activity remunerated from within the place visited" are considered tourists, according to the World Tourism Organization. Tourism was first described in 1976 by the Tourism Society of England as "the temporary short-term movement of people to destinations beyond the places where they ordinarily live and work and their activities during the stay at each destination. Movement for all reasons is included. In the past, man traveled in order to satisfy his basic necessities. Tourism was marketed by the industrial revolution. People from all over the world travel for pleasure, amusement, commerce, and to pursue their personal interests.

KEYWORDS:

Health Tourism, SWOT Analysis, Tourist Destination, Waterfall, World Tourism Organization.

INTRODUCTION

There are certain people who can be variously referred to as "waterfall lovers," "waterfall buffs," or "waterfall fans" among individuals who appreciate outdoor activity and take pleasure in landscape beauty The abundance of topographical books, travel literature, and tourist guidebooks that prominently portray waterfalls as a natural feature is proof that people of all ages like them. This enjoyment, along with advancements in technology, particularly in transportation, and the rise in leisure time over the past century have increased the number of visitors to waterfalls and resulted in the intentional exploitation of these well-liked natural features for tourism and recreation.

The analysis that follows examines waterfalls as resources for leisure and tourism, focusing on their functions as attractions. Since another article on this particular landscape experience of waterfalls is currently being written, no attempt is made to analyze in detail the aesthetic pleasures we obtain from them. Here, it is sufficient to note that waterfalls have long been viewed as beautiful, occasionally sublime, occasionally attractive, and have frequently served as inspiration for paintings and poems across a wide range of geographical and cultural contexts [1]. From the early Sung dynasty in China to Romantic Europe and North America, they have

inspired poets and painters, and in non-literate communities, waterfalls frequently appear in myth and legend. The view of rushing rivers and streams has long drawn admirers, and falls have been the main draw for travelers for a thousand years. In fact, Tivoli, famous for its gardens and waterfalls, became a well-liked Roman vacation destination around two thousand years ago. Many tourist destinations, including Niagara, Victoria, and Iguassu Falls, where waterfalls are the main draw, Yosemite and Yellowstone National Parks, Switzerland, Iceland, Norway, and New Zealand, where they are significant components of the scenic attractions, have benefited from this landscape preference [2]. Although there is a lot of literature on waterfalls, the majority of it is either impressionistic or just descriptive. Waterfalls as sources of energy have received a lot of attention, but scholarly literature has generally ignored them as sources of leisure and tourism. This study aims to fill this gap by showing how waterfalls can be classified and discussed within the theoretical frameworks created by economists, geographers, and other researchers who have contributed to the study of recreation and tourism as well as the exploitation of landscape resources.

To show the connections between the theoretical ideas covered earlier in the study, a more in-depth analysis of the island of Jamaica is used. Jamaica is a particularly good choice because, while most travel destinations see visitors for reasons other than waterfall attractions, Jamaica's tourism business heavily relies on these natural features. Additionally, an analysis of the extremely intensive exploitation of some of Jamaica's waterfalls and associated environmental issues offers a case study that may be helpful to those who want to encourage sustainable development in many regions of the world, especially where tourist destinations and attractions already exist or are planned [3].

Destinations

Like other tourist destinations, locations known for their waterfalls can be found in a variety of spatial scales, ranging from a relatively small locality to a large region that may encompass an entire county, extend widely across international boundaries, or even include several countries Although waterfalls are among the major attractions that the region, country, and city have to offer, none of the Scandinavian falls could be categorized as a destination, despite the fact that Scandinavia, Norway, and Bergen can all be considered and are marketed as tourist destinations. According to Mathieson and Wall, a tourist destination is a location with qualities that are well-known to enough potential tourists to warrant consideration as an entity that draws travel to itself independently of the attractions of other areas. Only two or three waterfalls Niagara, Victoria, and perhaps Iguassu Falls might be considered tourist destinations. These well-known natural wonders are alluring enough on their own to encourage long-distance travel and the construction of significant tourism infrastructure at or close to the location [4]. Additional attractions in the development include the well-liked white-water rafting, bungee jumping, and African culture and wildlife experiences near Victoria Falls.

The Victoria Falls, made famous by David Livingstone's "discovery" in 1855, were made accessible to tourists in 1904 when a railway from Cape Town arrived there. However, it wasn't until the rapid growth of international travel that followed the invention of the jet airliner that Victoria Falls became a well-liked tourist destination. However, Niagara Falls was already a well-known tourist attraction when the European world was still mostly ignorant of the interior of Africa. Niagara Falls will later develop a reputation as a top honeymoon destination. Although many other places are well-known for their waterfalls, it's not just these that draw travelers [5]. Instead, it is the magnificent scenery, of which the falls are significant even vital parts. This category includes a plethora of ski resorts and national parks, with Yosemite Valley in California and Lauterbrunnental in Switzerland serving as standout examples.

Natural or cultural features, or sometimes both, as well as infrastructure that supports and encourages their commercial exploitation, define tourist destinations [6]. Food and lodging required for a prolonged stay are among the basic services that a tourist site offers. In contrast, a tourist attraction may not always have these amenities, but it is customary for such locations to have refreshment stands and even restaurants. Additionally, a lot of tourist destinations provide lodging on-site or nearby. While the majority of waterfalls are still mostly in their natural state, several of the more well-known ones have undergone some development, maybe adding different types of food and drink establishments as well as lodging. Popular waterfalls frequently have a variety of dining options nearby, sometimes including good restaurants, and lodging options there can range from basic campgrounds to opulent hotels. The 19th-century Lodore Swiss Hotel in the English Lake District may now be better known for its gastronomy than for the stunning waterfalls on its property, the Lodore Falls that Wordsworth and Southey praised. These two Romantic poets of the nineteenth century unknowingly contributed to the popularity of the Lake District as a travel destination and to the public's awareness of many of that stunning region's aesthetic charms, including its waterfalls [7].

Tourist attractions are "place characteristics, often unique, such as the natural environment or historic artifacts, or events, like festivals and sporting events." It is clear that many locations considered to be tourist destinations could also qualify as attractions under this criterion. Many people consider the sites Goodall mentioned Yellowstone National Park, Venice, the Trinidad Carnival, and Wimbledon Tennis Tournament to be vacation destinations in and of themselves. The distinction between a destination and an attraction is occasionally one of scale, as in the case of New York City, Manhattan, Greenwich Village, and the Village Vanguard jazz club, but the size and draw of an attraction may be more crucial [8].

DISCUSSION

The Yorkshire Dales region is a popular tourist destination for many British visitors, but for the majority of American tourists, it is more likely to be seen as one of the numerous attractions that the English or British location has to offer. Numerous waterfalls, some relatively well known in Britain but generally unknown in America, are among the many noteworthy features of the Yorkshire Dales, which also include lovely valleys and scenic villages. Because of the widespread popularity of James Herriot's books on his life as a rural veterinarian, tourism in the Yorkshire Dales and Moors has increased. According to MacCannell's definition of "a tourist attraction as an empirical relationship between a tourist, a sight, and a marker (a piece of information about a sight)," Herriot's books and the popular television series based on them can be thought of as "markers."

The published works of the Lake Poets served as "markers" for the English Lake District in the early nineteenth century as it evolved into a well-liked tourist destination. Writings that mentioned specific localities, such as Aira Force and the Lodore Falls, two waterfalls mentioned in Wordsworth's poems, undoubtedly served as markers for these formerly obscure locations that were subsequently transformed into attractions. When Arthur Conan Doyle chose to have Sherlock Holmes killed off there, the Reichenbach Falls in Switzerland were already a well-known tourist destination, but the "marking" of this natural landscape feature was undoubtedly strengthened by the widely publicized and highly contentious nature of the fictional hero's death.

The creation of "markers" plays a significant part in today's massive global industry dedicated to promoting tourist destinations and attractions notes that "markers may take different forms: guidebooks, informational tablets, slide shows, travelogues, souvenir matchbooks, etc." According to MacCannell's concept, a visitor might be seen as a consumer of a service that was

produced through a process that included, among other things, a resource (the "sight") and information about it (the "marker"). While the "sight," the object of "the tourist gaze" is an important aspect of the subject, the site and situation, as well as the numerous ways to exploit and experience waterfalls, are also highlighted in the following discussion. This paper focuses on the resource, in this case waterfalls [9].

Falling Waters as Resources

It may be useful to think of waterfalls as natural gifts that may be used to serve human needs and exploited for profit, and to place them into a conceptual framework that categorizes and illustrates the connections between diverse natural resources. Before moving on, it is important to note that although "landscape" and "scenery" can be distinguished from one another the terms will be used almost interchangeably in the discussion that follows. Perhaps the term "landscape" is more frequently used in sense of "everything that I see and sense when I am outside," whereas the term "scenery" is more frequently used to refer to landscapes with which there is a purely aesthetic engagement. Although "Scenic resources" are addressed in typology of natural resources, they fit rather awkwardly under the category "Others" because they are neither properly classified as "Renewable" resources nor "Non-renewable" resources [10]. In his seminal work World Resources and Industries, Zimmermann (1933, 1951, 1964) discussed both natural and man-made landscapes and cited Isiah Bowman (1934), who said, "The dark and forbidding mountains of one epoch became the playground and inspiration of another epoch" (quoted in Zimmermann, 1964:13). Bowman's statement encapsulates the primary notion that Zimmermann developed in his work, which is that "resources are not, they become" (Zimmermann, 1964:21). However, despite mentioning "the waterfall that drives the turbines" (Zimmermann 1964:118), Zimmermann did not discuss the landscape as a resource for recreation and tourism, nor did he mention waterfalls as scenic resources.

However, Zimmermann's functional interpretation of resources, which was initially put forth in 1933, merits reiteration here. Zimmermann "argued that neither the environment as a whole nor specific elements of the environment are resources until they are, or are considered to be, capable of meeting human needs," In other words, resources are a totally arbitrary construct and a representation of judgment. Coal was therefore not a resource for many millions of years after it was deposited since no one could use it. In fact, coal was not a resource for the majority of human history because there were no individuals "whose wants and capabilities gave it utility". Resources "are not static, but expand and contract in response to human wants and human actions," The needs essential to an individual's or group's life, such as food and shelter, were separated by Zimmermann from "basic, or natural, creature, or existence wants" and "culture wants." The latter improve the quality of life through diversity and sophistication, such as a desire for beauty. The appreciation of the landscape is one way this is expressed [11].

A resource-based attraction can be broken down into three subcategories: those that are developed with additional attractions; those that are developed with existing resources; and those that are created resources, ranging from the adaptation of an existing resource to a new use to the creation of something completely nefarious. Historic structures, natural wonders, and picturesque locales are a few examples of attractions that fall under the first of these three categories. If parking lots, restrooms, snack bars, gift shops, interpretive centers, and other amenities are made available, the attractions in the first category may eventually be better categorized as being under the second. In some circumstances, such as at stately homes with zoos, wildlife parks and museums, and breathtaking gorges with white-water rafting, bungee jumping, and joy flights, the extra attractions may even rival the original one in significance. Old steam railways that are now only utilized for leisure and tourism, excavated flooded gravel

pits that are now used for water-based recreation, and completely new inventions like model villages and theme parks all fall under the third category.

The three categories of resource-based attractions can be usefully applied to waterfalls. Since many waterfalls may be visited by the general public in their natural state, they fall under the first category. These falls can be seen from mountain roads, on walks through the countryside, on hikes through the woods, etc. In some circumstances, particularly when the land is privately owned, an entrance fee might be levied. For the ease and safety of the visitors, these locations frequently include direction signs, footpaths, fences, and even viewing platforms. As a result, the location becomes a tourist attraction, making it better for certain visitors but potentially worsening it for others. Study cites an American author from the middle of the nineteenth century who cynically described how the Catskill Falls, which were revered by artists of the Hudson River school, had been exploited for tourists. The visitor could view the falls from a balcony there after purchasing refreshments in the bar room that overlooked the area for 25 cents, and a kid had "turned on" the falls for them by opening a sluice [12].

An intriguing English example is The Waterfalls Walk, a popular tourist destination since the eighteenth century and located close to the village of Ingleton in the Yorkshire Dales Thornton Foss or Force, a historic name that contains a northern English term for waterfall, and others, like the Rival Falls, whose names imply the creativity of the tourism marketer, are among the little falls and rapids that are connected by this pedestrian circuit on two confluent streams. When Ingleton became accessible by rail throughout the nineteenth century, it sparked commercial tourist growth and increased the attractiveness of the Waterfalls Walk. The 14 neighboring ravines with their collection of attractive waterfalls were once run by two different groups of tourism promoters, which sparked fierce competition and obnoxious commercialism. This scenario persisted until both attractions came under common ownership. “The approaches to these two gems of scenery were formerly rendered unsightly by the vulgar and enormous hoardings," one sensitive Edwardian guidebook author remarked. These have gladly been eliminated. However, the uphill and downhill directions that are present are rather sloppy and untidy. By the turn of the 20th century, there were also a few light refreshment huts built next to the Pecca Falls in addition to the usual direction signs, footpaths, wooden steps, and bridges, the upkeep of which was funded by the sixpence entrance fee.

A parking lot has recently been added, and concrete steps have been constructed in several locations. Near Pecca Falls, a tiny rest stop is still accessible Hardraw Force, one of England's most famous waterfalls and a favorite of Wordsworth and Turner, is located a few kilometers north of Ingleton, close to Hawes. The local inn, behind which the waterfall is located on ground that was originally owned by Lord Wharncliff, has long charged a fee for access to it. A bandstand was built in the narrow 30-meter fall's natural amphitheatre in the late Victorian era, and performances were occasionally given there before being resumed in 1959. The overhanging ledge of granite that formed the lip of the fall was shattered by the torrential stream, which was increased by an extraordinary thunderstorm, during Victoria's reign, causing the water to stop falling in a sheer curtain.

However, Lord Wharncliff overcame the natural processes and had the waterfall's lip restored. The artificial margin projected the water over the cliff face so that it was once more feasible to stroll behind the fall [13]. The footpath, the bandstand, the occasional concert, and the interference with erosive natural processes are all enhancements, but despite all of these additions, Hardraw Force is still best characterized as a tourist destination that is fundamentally an accessible natural resource. However, there are some waterfalls that fall into Patmore's second category due to the extent of human intervention and the availability of extra attractions.

CONCLUSION

When the most popular and accessible waterfalls are fully utilized, new resources may inevitably be developed, especially if overdevelopment and environmental degradation make them less alluring. These include high-quality waterfalls that are scenic resources in relatively distant or difficult-to-reach locations, as well as other possibly inferior resources that have the geographic benefit of being close to significant population and tourism centers. The latter category's waterfalls are unmistakably examples of user-oriented attractions, whilst the former's have some characteristics of a resource-based recreation area. The concept of resource-based and user-oriented recreation sites and attractions is one that is extremely relative, as is made obvious by this discussion of waterfalls. In Kingston, Jamaica, a "waterfall lover" may particularly enjoy day trips to Dunn's River Falls, or to the farther-off but less heavily developed YS or Reach Falls, but if time is of the essence, they may be content to make do with the less appealing Cane River Falls, located a few kilometers to the east of the city. For the purposes of this illustration, Dunn's River, YS, and Reach Falls could be viewed as resource-based attractions, whereas those along the Cane River must be seen as user-oriented.

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CHAPTER 3

INTRODUCTION TO THE PHYSIOGRAPHY OF INDIA

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ABSTRACT:

The study of the Earth's physical patterns and processes, including geomorphology, hydrology, soil, rocks, biogeography, and the effects of tectonic forces on landscapes, is known as physiography. This research used a systematic search and gathering of publications and secondary sources to examine the physiographic characteristics of India due to its different geographical features. There was a detailed and pictorial discussion of the physiography of India. The northern mountain range, northern plains, peninsular plateau, coastal plains, and islands the eastern and western coastal plains, Andaman and Nicobar Islands are among the terrain types in India that are highlighted in this study for their fundamental physiographic divisions, sub-divisions, and socioeconomic functions. This overview came to the conclusion that India's physiography is complicated, varied, and can be divided into four sections with various characteristics. In more detail, the Himalayan Range is a mountainous area that was created by fold mountain processes and is located in the northern part of the nation. The Ganges River contributed significantly to the large agricultural activities in the Indo Gangetic Plain, which were well known at the time. The varied landforms of India have a significant influence on the cultural and economic growth of the nation. However, this study also showed that the plateau region in the southern and central parts of the nation was geographically diverse. The various landscapes of India influenced the socioeconomic traits of the Indian society and, as a result, aided in India's national growth.

KEYWORDS:

Indo Gangetic Plains, Physical patterns, Physiography of India,

INTRODUCTION

The study of the Earth's physical patterns and processes is known as physiography. Geomorphology, hydrology, soil, rocks, biogeography, and tectonic influences on landscapes are all included in this field These landscapes were completely man-made. Because it gives a broad scale of the planet's landforms, mapping is a crucial component of physiographic research. India was selected for the study of an area's physiography because of its variety of landforms. The four divisions used by contemporary geographers to divide India are the northern mountain area, the northern enormous plains, the peninsular plateau, the coastal plains, and the islands. These divisions fulfill a variety of purposes and offer residents a variety of resources, including water, farms, woodlands, and so forth [1]. By making use of these resources, the government and the populace may generate money, ensuring the long-term viability of India's national growth.

For the purpose of offering qualitative and quantitative justifications for landscape development, an understanding of India's physiography is essential. They include landscapes with mountains, plains, valleys, plateaus, coastal areas, and other features diverse landforms in India might play diverse roles in the development of various cultures. For instance, folks who live close to the Ganges River favor agriculture over those who live in the Himalayas. Additionally, further study into the connections between Indian cultural practices and

physiography may result from this research. This is crucial because Ng: The Physiography of India: An Overview has historically drawn inspiration from the environment. In addition, this study examines the ways in which cultural and economic exchanges help people in one region connect with those in other regions. This study describes the impact of India's natural geography on human activity in the area. It should hopefully be usable as a resource for further research [2].

Discovering the origins of India's physiography is the aim of this study. The following objectives have been established as a result: (1) to identify the principal physiographic divisions of India; (2) to examine the physiography of India's sub-divisions; and (3) to appreciate the roles that each division plays in India's socioeconomic system.

Resources and Procedures

This study was conducted using a literature survey, which entails a search of publications including reports, journals, articles, and books. The terms "physiography," "India," and physiographic divisions such "Northern mountain area," "Northern plains," "Peninsular plateau," and "Coastal plains and islands" were used to search these secondary data [3]. The records were further filtered to remove geographic data that wasn't pertinent to the study's main topics. The major physiographic divisions and subdivisions of India were used to organize the literature evaluation. Google Image and Google Map-derived maps were used to illustrate the characteristics of these important divisions. The relationship between India's physiography and socio-economics was also researched and evaluated using official websites like the India Commission Website.

Field of study

India is a country in Asia that is situated at 0° latitude on the Equator. The precise position of this nation is between latitudes 8o4' and 37o6' N and longitudes 68o7' and 97o25' E (Google Map). This nation is located in southern Asia, bordering the Bay of Bengal to the east and the Arabian Sea to the west. New Delhi, the administrative hub of India, is the country's capital. About 2.42% of the world's total area, or 32, 87,782 km^2, is covered by the whole surface area of India. This is a little bit bigger than one-third of the size of the US. East to west distance is 2933 km, while north to south distance is 3214 km. It has a 6083 km long coastline and a 15200 km long land border [4].

The physiology of India

India is a diverse country. The terrain of this nation is made up of large mountains, rivers, expansive plateaus and plains, long coastlines, etc. India can be divided into four physiographic regions: the peninsular plateau, the coastal plains, the northern mountain region, and the islands. In India, every type of physiography is important, especially for the growth of the social and economic systems. While the tourism sector is benefited by mountain sites, locals grow crops on the rich in minerals and nutrients lush plains of the north. While the Ganges River serves as a major Holy River and draws numerous domestic and foreign tourists, which supports the nation's economy [5]. These distinctive landscapes have also had an impact on human lifestyles.

The youngest and highest mountain range in the globe is the Himalayan Range in the north, which is thought to be about 70 million years old. Himalaya, a mountain range blanketed in snow, is known as "Abode of Snow" in Sanskrit. The Himalayas, which form the northern border between India and Tibet, stretch for around 2415 kilometers (1500 miles) in an arc-shaped pattern from west to east. The Indo-Australian plate collided with the Eurasian plate to

create the Himalaya landform, often known as the "Fold Mountains". Scientists estimate that the Indo-Australian plate is still moving at a rate of 67 millimeters per year, which means that the Himalaya are still rising at a rate of more than 1 centimeter each year.

As a result, the region is seismically active and geologically unstable. Its width at the boundaries and over certain Asian nations varies from 240 to 330 km. The 750 000 square kilometer-long Himalaya range runs through the countries of India, Pakistan, Afghanistan, China, Myanmar, Nepal, and Bhutan. The Himalayan Mountains are part of India's northern mountain range. They are the world's tallest mountain ranges. They have the highest peaks, the largest glaciers, and deepest valleys. Northern India and the Tibetan plateau are divided by these mountain ranges, which run from the Pamir Knot in the west to Purvanchal in the east. This area is made up of the mountain ranges of Ladakh, Zaskar, the Himalayas, and the eastern highlands. The altitude is 6000 meters on average [6]. Mount Godwin Austin, India's tallest mountain at 8611 meters, is located in the Karakoram Range.

The highest region in the world, the northernmost part of the Himalaya Range has an average elevation of 6,000 meters, with Mount Everest (8,848 meters) as its highest peak, followed by Mount Makalu (8,481 meters), Mansalu (8,156 meters), Annapurna (8,078 meters), Kanchenjungs (8,598 meters), and Nanga Parbat (8,126 meters) (US Library of Congress, 2013). The Himalayas are an arc-shaped mountain range that are a part of the northern mountain range and extend for around 2400 km in a NW-SE direction (

The highest location in the world, this mountainous territory has a surface area of roughly 5 lakh km^2. The region is 500 m to 3000 m above sea level on average. Three parallel mountain ranges, numerous deep valleys, and vast plateaus make up this geographical boundary. The idea that the area was originally covered by sea is supported by the discovery of several marine species' remnants at various locations on the mountain ranges. Mountain ranges gradually lose height as they approach the eastern portions of the Northern mountainous regions. The Lesser Himalaya, Great Himalaya, and Tethys Himalayas are the three divisions of the Himalaya Range [7]. North of the Sub-Himalayan Range and south of the Great Himalayas are the Lesser Himalayas, often referred to as the Lower Himalaya Range. The mountains are between 1800 and 4600 meters high. These mountains were created by millions of years of folding, faulting, and over pushing (US Library of Congress, 2013).

The Tibetan Plateau is separated from the plains of the Indian subcontinent by the Great Himalayas Mountain range. In this area, there are more than 100 mountains that are higher than 7,200 meters. This region is the highest, with towering peaks that are often 6,000 meters tall and covered in snow. On several peaks, elevations of 8000 meters are attained India's culture has been significantly influenced by Mount Everest, which rises to a height of 8848 meters and is located between Tibet and the Himalayan monarchy (US Library of Congress, 2013). As a result of an ongoing collision between two continental tectonic plates, the Tethys Himalayas, which span over 2,400 km between the Namche Barwa syntaxes in Tibet and the Nanga Parbat syntaxes in Pakistan were created. This vast mountain range was shaped by weathering and erosion and was created by tectonic forces. An over thrusting of crystalline terrains onto the Indian Plate, a foreland basin (the Ganga Basin), and a steeper thrust fault (a ramp) beneath the Great Himalayas may all be seen in this simplified north-south cross section of the Himalayas [8].

The Himalayan Range is important to India's socioeconomic structure. The natural wall along the northern borders is formed by this mountain range. This acts as a natural defense for the nation against attacks from the north. Additionally, it shields India from chilly northerly winds (Indian Quick Facts Official Portal, 2013). As a result, there is no need for Indian citizens to

endure from extreme cold because agricultural activities are being done in climates and temperatures that are ideal for them. Rich soil is brought to the plains by the rivers that originate in the Himalayas. The Indus, Ganga, and Brahmaputra rivers all year-round supply water to this enormous plain. The high volume of river water can also be utilised to produce hydroelectricity. Due to their potential for producing energy and relatively high annual water output, dams are being planned for construction in three of the main Himalayan River basins in India. The East Himalaya offers a significant amount of untapped tourism potential [9]. In North East India, just south of Sikkim, are the always snow-capped mountains, lush tropical and temperate forests, trickling streams, and the diverse flora and fauna. With its moderate climate and laid-back character, Darjeeling offers the ideal setting for a hill resort. Large expanses of rolling green tea gardens dot the terrain, which is characterized by lush hills and valleys that are vibrant in color. The third-tallest mountain on Earth, Mt. Kangchenjunga, towers over the northern horizon giving the nation a stunning aura that enthralls the senses (The Indian Analyst Official Portal, 2007).

Plains of The North

South of the Himalayan Region is where you'll find the Northern Plains. It also goes by the name Gangetic Plain. Between the Himalayas in the north and the Deccan Plateau in the south lies a sizable plain and flat area. This plain stretches for around 2400 km from Punjab in the west to Assam in the east, with a breadth that varies from 150 km in the east to about 300 km in the west. It covers the Union Territory of Delhi, the States of Punjab, Haryana, Uttar Pradesh, Bihar, West Bengal, and small portions of Assam (Indian Quick Facts Official Portal, 2013). According to Richardson and Thorne (2001), the sediments carried by the rivers from the Himalayas formed the foundation of the soil in this plain. Alluvial plain is the name given to such a fertile plain. One of the world's largest and most productive plains is this one. It is the plain with the densest population. In addition, this is where most of India's crops are grown. This plain is often traversed by the Sutlej, Ganga, and Brahmaputra, as well as their tributaries. The Sutlej Basin, the Ganga Basin, and the Brahmaputra Basin are the three basins that make up this plain (Indian Quick Facts Official Portal, 2013). A river's basin is the region through which it and its tributaries flow. Each basin has the following qualities and purposes.

DISCUSSION

The Western portion of the Northern plain is where the Sutlej Basin is located. This region is crossed by the Sutlej River and the Beas tributary. Before the Sutlej enters Pakistan, Beas joins it at Harike. Punjab and Haryana are two of the basin's most significant states. This basin includes Chandigarh, a Union Territory. Wells, tube-wells, and canals are also employed for irrigation in this area because it doesn't get enough rain. The Sutlej Basin's primary crop is wheat. A lot of other crops are also produced in huge quantities, including rice, sugarcane, cotton, gram, and oil seeds. The Sutlej Basin is a national granary that provides rice and wheat to other regions of the nation. This region experiences extremely scorching summers and extremely chilly winters. The inhabitants of this basin are extremely healthy and diligent workers. They produce competent warriors for our army. Amritsar, Jalandhar, Ludhiana, Patiala, Chandigarh, Ambala, Kurukshetra, Karnal, and Sonipat [10].

The Sutlej Basin is located east of the Ganga Basin. The vast portion of the productive Northern Plain is included in it. Because of this, this plain is often referred to as the Gangetic Plain. The states of Uttar Pradesh, Bihar, West Bengal, and the Union Territory of Delhi are all part of the Ganga Basin. This region is traversed by the Ganga, Yamuna, and their tributaries. The Gangotri Glacier in the Himalayas is where the Ganga originates. The Yamuna originates in Yamunotri, a neighboring glacier. Before the Ganga reaches Haridwar, it is joined by the

Bhagirathi, Mandakini, Alaknanda, and a few more streams. The Ganga joins the plains at Haridwar, where it swells to become a sizable river. The most sacred place is recognized as being in Haridwar. Faridabad is one of the important towns and industrial hubs in this basin. The easternmost portion of the productive Northern plain is known as the Brahmaputra Basin. Mansarovar Lake in Tibet is the source of the Brahmaputra River, sometimes referred to as Tsang-Po. It takes a southerly swing and passes across the eastern Himalayas to enter India [11].

After a long valley and a westward swing, the Brahmaputra enters the Assam plain before turning south and entering Bangladesh. After there, it combines with Padma and runs into the delta of the Sundarbans. Assam has a constrained plain. Hills and mountains round this basin on three sides. The Khasi, Garo, Jaintia, and Naga Hills form its southern border. The alluvial soil that makes up these plains was left behind by rivers. The outcome is that the soil is incredibly fertile and soft. The main agricultural products grown here include jute, wheat, rice, sugarcane, legumes, and oil seeds. This area is referred to as India's "food bowl."

Additionally, canals, tube-wells, and irrigation wells can be drilled. This region is now India's leading producer of food grains because to effective irrigation. This plain receives a sufficient amount of precipitation.

There are many lakes, rivers, and streams nearby. There is a ton of vegetation as well. These components affect the climate and help to make it bearable. The Northern Plains experience extremely chilly winters and extremely sweltering summers (Indian Quick Facts Official Portal, 2013). The economic growth of India depends on this plain. Communication and transportation are easy because the land is level. There is a good rail and road network that provides access to this plain. The distribution of some important industries is same throughout the region, including iron and steel, jute, cement, sugar, and textile [12].

Hindus consider the Ganges to be sacred along its whole length. Hindus bathe in the river's waters all the way along its length, offering flowers and rose petals as well as small clay dishes filled with oil that they float in the river as a form of respect to their gods and ancestors. Although its water is revered as holy, pollution is tainting it. Along its banks, waste from several cities and industry pollutes the water. The water is unfit for human consumption. To clean the water from this pollution, the government has developed a plan called as the Ganga Action Plan. In order to conserve this river, some restrictions have been put into place that forbid the disposal of rubbish into rivers

Continent of the Peninsula

The Peninsular Plateau encompasses a major portion of India. It consists of undulating topography that is higher than the flat Northern Plain of the Ganga and the Satluj or the coastal plains to the east and west. This plateau stretches for around 1600 km from north to south and for about 1400 km from east to west. The terrain of this region is varied, with mountains, plateaus, and valleys. This physiographic division's plateau averages an elevation of more than 400 mean sea levels. The highest mountain is Anamudi (2695m). The majority of the rivers in this area flow eastward. In this region, there are significant mineral deposits. The peninsular plateau is divided into two unequal halves, the northern and southern parts, by the Narmada River. The Peninsular Plateau, however, can generally be divided into three sections. The Deccan Plateau is in the south, the Central Highlands are in the north, and the Chhotanagpur Plateau is in the southeast [13].

The Bundelkhand Bhander, Baghel, and Malwa Plateau make up the Central Highlands. The Narmada rift valley, which was produced by strong metamorphic and igneous rocks, is located

to the north of these highlands. The plateau is drained by the Ganga River and Yamuna River's southern tributaries. The granite and gneisses that make up the Bundelkhand Plateau, which is a portion of the central highlands. A dissected lava plateau covered in black soil is the Malwa Plateau (Indian Quick Facts Official Portal, 2013). The largest plateau south of the Narmada River is the Deccan Plateau. According to the Indian Quick Facts Official Portal (2013), it covers the Western Ghats north of 16o north latitude, the Maharashtra plateau (apart from the area east of Nagpur), and the neighboring states of Madhya Pradesh, Karnataka, and Andhra Pradesh.

The tallest mountain on the Chhotanagpur Plateau, Parasnath (1,366 m), is located in the northeastern part of the Indian Plateau, which also encompasses the states of West Bengal, Madhya Pradesh, and Bihar. It consists of the Rajmahal Hills in the northeast, the Ranchi Plateau in the south, and the Hazaribagh Plateau in the north. The "Ruhr of India" is how Indian Quick Facts Official Portal (2013) describes it. It has protected lands and abundant natural resources. Sloping scarps or Ghats encircle a large portion of the plateau. The plateau has a fairly steep scarp on its western side. River valleys separate the Ghats into discrete hilly regions to the east. In some locations, the ground slopes down to the Northern Plains, but in other places, there is a scarp. Some rivers that travel from the west to the east originate in this area. The majority of the northern terrain is irrigated by the Godavari River and its confluents, which include the Indrvati River. The Godavari River rises in the Western Ghats and flows east into the Bay of Bengal. In order to irrigate water supplies for agricultural activities, the Indian Peninsular Plateau is crucial (Indian Quick Facts Official Portal, 2013). The Indo-Gangetic Plain is India's most significant region economically. Due to the rich agricultural soil on the plateau, there is a fairly high population density. The plains, with approximately 1 billion people living there on 700,000 km2, are one of the most populated regions on Earth. Karachi, Hyderabad, Multan, Islamabad, Rawalpindi, Faisalabad, Lahore, Amritsar, Bathinda, Jammu, Jalandhar, Pathankot, Ludhiana, Chandigarh, Delhi, Jaipur, Kampur, Lucknow, Allahabad, Varanasi, Patna, Kolkata, Guwahati, and Dhaka are among its important cities. The plain is homogenous in topography, and the only significant natural features are the floodplain bluffs and other landforms caused by river erosion and channel alterations. Rice, wheat, maize, sugarcane, and cotton are the main agricultural products grown in the India Great Plain (Indian Quick Facts Official Portal, 2013). The southwest monsoon is the principal source of rain, and it usually provides enough for all agricultural needs.

The Indus and Ganga-Brahmaputra River systems' vast floodplains are referred to as the Great Plains or Indus-Ganga Plains. They parallel the Himalaya Mountains, which drain most of northern and eastern India from Jammu and Kashmir in the west to Assam in the east Between the Himalayan in the north and the Great Plain Peninsular Plateau in the south, these plains spread in an east-west orientation. The plains cover an area of 700,000 km2 and vary in breadth by several hundred kilometers throughout their length. The Ganga and the Indus are the main rivers of this system, and their tributaries include the Beas, Yamuna, Gomti, Ravi, Chambal, Sutlej, and Chenab. The rivers that originate in the Himalaya supply plenty of water for important irrigation projects. It is relatively simple to build irrigation canals and have inland navigation because the area is practically level. It features top-notch highways and railroads, which are beneficial for the development of numerous enterprises. It is referred to as "The Heart of India" and is home to 40% of the country's population. Consequently, this region is crucial to India's economy.

CONCLUSION

India's physiography is intricate and can be divided into four main regions, each with its own unique traits. The process of folding mountains created the mountainous Himalayan Range in

the north of the nation. While the large-scale agriculture practiced on the Indo-Gangetic Plain is well known. While the plateau region is located in the southern and central parts of the nation. Last but not least, vast deltas that occupy a sizeable portion of the land are found in coastal and island locations. India's culture and economy have been significantly impacted by the variety of its landforms.

This shows that these locations are popular tourist destinations, drawing a lot of visitors who come to admire India's historical and cultural activities. The high Himalayan regions also act as a refuge for a wide variety of biodiversity, including wildlife and medicinal plants. As a result, India's varied landforms have influenced its socioeconomic features and aided in the country's growth.

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CHAPTER 4

EXTRA-PENINSULAR INDIA: A BRIEF DESCRIPTION

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ABSTRACT:

The physical characteristics of the Indian subcontinent are extremely intricate and varied. Many geologists and geographers have examined the geological and physiographic variety of the Subcontinent on a regional level because its geological formations and landforms are geographically coterminous. The Himalayan Mountain Ranges are referred to as "Extra-Peninsular India" in the regionalization plan put forth by most geologists and some geographers. However, when used literally, this word includes geological/physiographic units other than Peninsular India, such as the Indo-Gangetic Plains and the Himalayan Mountain Ranges. As a result, confusion is caused by the discrepancy between the phrase "Extra-Peninsular India" and its true meaning. The paper discusses the appropriateness of this expression and urges its replacement with separate terms Himalaya Mountain Ranges and Indo-Gangetic Plains after reviewing numerous classical and modern works of literature related to the nomenclature of India's geological/physiographic units. The report makes the case that this straightforward language not only clears up the current uncertainty but also better accurately expresses the region's geological and physiographic uniqueness.

KEYWORDS:

Extra-Peninsular India, Himalayan Frontal Thrust, Indo-Gangetic Plains, Physiographic Uniqueness, Regionalization Plan.

INTRODUCTION

The Indian Subcontinent is exceptional for its diverse physical features, which include the Himalayan Mountain ranges in the northern boundary, Peninsular India's hills, plateaus, and uplands in the southern portion, and the Indo-Gangetic Plains in the middle. These physical characteristics indicate a billion years of geological structure and history Geologists and geographers have regionalized the Indian Subcontinent based on its geological and physiographic features in an effort to comprehend its complexity and diversity. Most geologists and some geographers divide the Indian Subcontinent into three regions: the Peninsular, the Extra-Peninsular, and the Indo-Gangetic Plain. Some authors preferred the Peninsular and Extra-Peninsular regionalization schemes [1]. Others, however, have suggested regionalization on a four- or five-fold scale. As it is, there are arguments and counterarguments in literature about both the regionalization plan and the terminology used to describe some of the regions.

The word "Extra-peninsula" should, however, refer to all geological and physiographic regions of the Indian Subcontinent other than Peninsular India, as indicated by its literal meaning. This means that the phrase encompasses both the Indo-Gangetic Plains and the Himalayan Mountain Ranges, making the two-fold system appropriate given the regionalization of the Subcontinent through the use of the names "Peninsular India" and "Extra Peninsular India. In this situation, the debate proceeds in a catechistic manner by posing a few questions before addressing them. Why is the Himalayan Mountain region referred to as "Extra-Peninsular India" How far is it appropriate to use this definition of the phrase "Extra-Peninsular region"? What role does the Indo-Gangetic Plain play in this regionalization plan? Is it possible to construct a regionalization system that encompasses the whole Indian Subcontinent without causing any

ambiguity in the terminology used to describe those regions? What kind of regionalization system will there be, and what terminology will better describe those regions. And lastly, are there any potential implications of these claims for the regional geological and geographical research of India? All of these issues relating to the regionalization of the Indian Subcontinent have been studied, and this article suggests suitable nomenclatures for those regions.

Plans for regionalization

Geologists and geographers have regionalized the Indian Subcontinent in different ways based on geological and physiographic / geographic characteristics, respectively. For instance, Pascoe classified the Indian Subcontinent into the Peninsula, Extra Peninsula, and Indo-Gangetic Alluvial Plains, three major geological zones [2]. Baluchistan, the North-West Frontier, a piece of Punjab, a region to the north-west of the Jhelum, the Salt Range, the Himalaya, Burma, and the Andaman and Nicobar Islands in the Extra Peninsula were all mentioned by Pascoe the Peninsula, the Extra-Peninsula, and the Great Indo-Gangetic Plains are the three geological and physiographic divisions that Wadia separated India into. The same division of India into three physical regions has been made by Krishnan (1960: 1): the Peninsula or Peninsular Shield (lying to the south of the plains of the Indus and Ganga River systems), the Indo-Gangetic alluvial plains (stretching across northern India from Assam and Bengal through Bihar, United Provinces (Uttar Pradesh), to the Punjab and Sind on the west), and the extra-Peninsula (including the mighty Himalayan range and

The Peninsular, Extra Peninsular, and Indo-Gangetic Plains were regarded by Ramakrishnan and Vaidyanadhan as the three main physical entities of the Indian Subcontinent with distinct geological and geomorphological characteristics. It's interesting to note that while certain geographers, advocated the three divisions of the Indian Subcontinent, they referred to them as physiographic areas [3]. The geology (stratigraphical, structural, petrological, geochronological, and tectonic properties) and geographic locations of the three divisions exhibit stark variation as follows: "The physiographic contrasts between these macro-regions are most striking; generally speaking, the Peninsula is dominated by an open senile topography, witness to vast periods of geological quiescence while the Himalaya displays the most youthful and highly differentiated relief on the face of the earth, and the Indo-Gangetic Plains presents a relatively young relief."

Additionally, some geographers have suggested categorizing the Indian Subcontinent in four or five different ways. According to relief and physiographic features, Ahmad divided the Indian Subcontinent into Extra-Peninsular India, Northern Plains, Peninsular India, and Coastal Plains [4]. Four zones have been identified on the Indian Subcontinent by Spate and Singh. However, in Spate's regional map from 1952, the coastal plains were included in Peninsular India along with a separate region made up of the islands. On the other hand, viewed the Indian coast and islands as a unified physiographic entity. The Indian Subcontinent has been classified into five primary provinces by Valdiya.

DISCUSSION

Peninsular India is regarded as a distinct geological entity and the primordial unit. Peninsular India is geologically connected to and chronologically dependent upon the development of the other two physiographic zones. In accordance with plate-tectonic reconstruction models, the Indian Subcontinent (which would later become Peninsular India) split off from Gondwanaland during the breakup of Pangea at around 130 Ma. It then moved north before colliding with Eurasia to push up the early Himalaya at around 40–50. The enormous rivers Ganga, Indus, and Brahmaputra, as well as their countless tributaries, were responsible for creating the Indo-Gangetic Plains, which now make up a sizeable portion of the IndoGangetic basin and are

situated between the Himalayan mountain ranges and Peninsular India [5]. The Himalaya was raised as a result of the collision of the India and Eurasia plates, creating the active Indo-Gangetic Basin. Geological/physiographic division was first proposed by Suess (1893–1909). Interpretation by the authors.

Extra-Peninsular India or the mountains of the Himalaya

The Indo-Gangetic depression is a "foredeep," according to Burrard. The inflexible land mass of the Indian Peninsula prevented the Eurasian plate from migrating southward, creating this "fore-deep".

As sedimentation progressed, it widened and deepened until the Late Quaternary (1.5–1.7 million years ago). Along the Himalayan Frontal Thrust (HFT), it split during this time into two unequal portions; the northern 25–45 km wide belt developed into the Siwalik Ranges, while the southern 200–450 km wide zone became the sinking basin. The huge Indo-Gangetic Plains were finally formed by the fast deposition of sediments from the Himalaya and, to a lesser extent, from the northern hills of Peninsular India. Aeolian deposits from western and northern India are also present here. Precambrian rocks from Peninsular India's Late Proterozoic period make up the basement of this plain. In reality, alluvium has accumulated on Precambrian basement rocks along the whole Indo-Gangetic plains. In a nutshell, Peninsular India is the oldest physiographic feature of the Indian Subcontinent, followed by the Indo-Gangetic Plain, which is younger, and the Himalaya, which has a chronology in between these two features [6].

The validity and suitability of the phrase "Extra-Peninsular India" are questioned. As was said above, events related to the evolution of Peninsular India and the Himalaya have dominated the major period of the Indian Subcontinent's geological history. One of these is the geologically secondary and dependent formation of the Himalaya in regard to Peninsular India [7]. Therefore, it is acceptable to use the term "Extra-Peninsular" for two reasons: (a) Peninsular India's dominant position in terms of geographical distribution and its primary signature in the Indian Subcontinent; and (b) its influence on the formation of the Himalaya and the Indo-Gangetic Plain.

The names Peninsular India and Extra-Peninsular India may have been chosen since both of these units are located directly across from one another and play a significant role in India's geological history. On the other hand, the Peninsula and Extra Peninsula (the Himalayas), in contrast, have essential grounds, according to study, but the Indo-Gangetic plains of India are not autonomous geological entities. The Indo-Gangetic Plains were created by sediments from the Himalaya and, to a lesser extent, from the highlands of northern Peninsular India. As a result, it has only been recognized as an independent physiographic unit since the late Quaternary.

In addition, historically speaking, geologists have not historically been as interested in studying the Indo-Gangetic Plains as they have been Peninsular India and the Himalaya. This has just lately changed. The alluvial deposits of the rivers of the Indo-Gangetic systems, which were carried down from the Himalayas and deposited at its foot, are all that remain of India's ancient geological past. Actually, its geological significance is still largely limited to the deposits of rich alluvial soils and the development of the river system. As shown in Figure 1 Peninsular Mountains.

Figure 1: Illustrate the Peninsular Mountains [prepp].

The western flank of the Aravali Range, which is close to Delhi, serves as the northern boundary of the Peninsular Block. From Kachchh, the line may be drawn irregularly parallel to the Yamuna and Ganga rivers until it reaches the Rajmahal Hills and the Ganga delta [8]. Other extensions of this block include the Karbi Anglong and Meghalaya Plateau in the northeast and Rajasthan in the west. The Malda fault in West Bengal separates the Chotanagpur plateau's northeastern portions from it. This block is covered in Rajasthan's desert and other desert-like elements. The majority of the Peninsula's structure is made up of a massive complex of extremely old gneisses and granites. With the exception of some of its western shore, which is submerged beneath the sea, and some other parts that changed owing to tectonic activity without changing the original basement, the Peninsula has stood like a hard rock since the Cambrian epoch. It has experienced a variety of vertical movements and block faulting as a member of the Indo-Australian Plate. The Satpura block, the Tapi, the Mahanadi, and the rift valleys of the Narma There are nine mountains as examples. The Palkonda range, the Mahendragiri hills, the Nallamala hills, the Javadi hills, the Veliconda hills, and other remnant and remnant mountains make up the majority of the Peninsula.

Here, the river valleys have modest grades and are shallow. Can you compute the gradients of the rivers in the Himalayas and the Peninsular and make comparisons? The majority of east-flowing rivers create deltas before reaching the Bay of Bengal. Important examples include the deltas created by the Mahanadi, Krishna, Kaveri, and Godavari. Unlike the old, strong, and stable Peninsular Block, the Himalayas and other Peninsular mountains have a variable geological structure [9]. As a result, they continue to be impacted by the interaction of exogenic and endogenic pressures, which leads to the formation of faults, folds, and thrust plains. These mountains, which have tectonic origins, are divided into sections by young, swift-moving rivers. This level is characterized by a variety of landforms, including gorges, V-shaped valleys, rapids, waterfalls, etc. The plains created by the rivers Indus, Ganga, and Brahmaputra make up India's third geological division. It was initially a geo-synclinal depression that reached its peak development around 64 million years ago, during the third stage of the construction of the Himalayan mountains. Since then, sediments from the Himalayan and

Peninsular rivers have been slowly adding to its volume. These plains have alluvial deposits with an average depth of 1,000–2,000 m. The aforementioned explanation makes clear that the various regions of India differ significantly in terms of their geological structure, which has a considerable impact on other relevant elements. Physiographic and relief variations are significant among these. The geological and geomorphological processes present in the Indian subcontinent have had a significant impact on the relief and physiography of the country. An area's "physiography" results from its structure, processes, and developmental stage. The physical characteristics of India's geography are incredibly diverse. The north contains a huge area of rough landscape made up of numerous mountain ranges with a variety of peak shapes, lovely valleys, and deep canyons. The south is made up of stable table terrain with deeply cut plateaus, bare rocks, and extensive scarp systems [10]. The enormous north Indian plain is located between these two.

CONCLUSION

Most geologists and some geographers refer to the Himalaya as "Extra-Peninsular India" as a matter of convention. However, it confounds both teachers' and students' minds. Here, two potential regionalization/nomenclature strategies are put out in an effort to eliminate any ambiguity. It is advised to use a two-fold categorization scheme for the physiographic division of the Indian Subcontinent the Peninsular and the Extra Peninsular, as Peninsular India is the mother to all other physiographic divisions. The Himalaya and Indo-Gangetic Plain regions should be separated off from the Extra-Peninsular zone. There are certain benefits to using this nomenclature system for Indian Subcontinent regions. First, it maintains the common usage of the word "Extra-Peninsular," and second, it ensures "peninsular India's" dominance in the Indian Subcontinent. Additionally, the word "Extra-Peninsular" literally refers to the physiographic regions of the Indian Subcontinent outside of the "peninsula." To give each of the three major physiographic units their own distinct identity, the term "Extra-peninsula" should be completely dropped from the system of physiographic regionalization and replaced with the names "Peninsular India," "the Himalaya and associated mountains," and "the Indo-Gangetic Plains." Adopting this approach of region-specific naming has some benefits. First, by assigning each region the same rank of significance, it correctly conveys the independent uniqueness of each region, regardless of their geological association and relation.

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CHAPTER 5

COMPARISON OF NICOBARESE AND GREAT AND AMANESE: AN OVERVIEW

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ABSTRACT:

The Ten Degree Channel divides the two independent Bay of Bengal archipelagos of the Andaman Islands and Nicobar Islands. Because the geological process that created both the Andaman Islands and the Nicobar Islands was the same, their geology, climate, soil, and native plants are also comparable. Both the Andaman Islands and the Nicobar Islands were home to a tribal population before the British invaded these islands in the 19th century. Despite having a similar geographical setting, the tribes on the Andaman and Nicobar Islands were very diverse from one another. The research evaluates the similarities and differences between the two tribes using Great Andamanese from the Andaman Islands and Nicobarese from the Nicobar Islands. The article compares the physical environment differences between the Andaman Islands and the Nicobar Islands and evaluates the similarities and differences between the Great Andamanese and the Nicobarese

KEYWORDS:

Cultural Practices, Great Andamanese, Nicobarese, Social, Tuhet, Tribal Population.

INTRODUCTION

The A&N Islands are situated at the convergent plate border between the Indian Plate and the Eurasian Plate on the Burma Microplate. The Arakan Range in Burma to the north and the Sumatran Barisan Ranges to the south form an underwater mountain range, with the tallest peaks being represented by the A&N Islands. Both the Andaman and Nicobar Islands are mountainous, rough, and undulating. The north-south axis of the fold undersea mountain ranges. Deep valleys separate the parallel ridges that are present. These depressions can lay as plain stretches or the sea encroaches and forms a longitudinal bay. In addition, the northern Andaman Island is higher than the southern part, and in the Nicobar Islands, the southern part, i.e. the Great Nicobar Island, is higher than the northern part. The islands are tallest in the east and progressively decline on the west. Because of the region's frequent, heavy rains, the hills' moderate to steep slopes are vulnerable to erosion [1].

1. The Saddle Peak, located in the North Andaman, is the island's highest peak at 731 meters. The island's shoreline is highly indented, giving the islands some of the best harbors in the world.
2. All of the Andaman and Nicobar Islands are encircled by bordering coral reefs. 41.17 percent of India's total 2329.9 sq km of coral reefs are in the A&N Islands.
3. The shallow oceans and coastlines all around the A&N Islands. Coral reef development surrounding the A&N Islands is supported by the tropical environment and extensive mangrove networks.
4. On the western edge of the A&N Islands, there are large coral reefs. This is because the terrain progressively slopes westward, creating shallow continental shelves that are ideal for the development of coral reef.

Drainage: Despite receiving considerable rainfall for more than 8 months out of the year, the A&N Islands lack rivers and significant ground water. Several ephemeral streams that start during the monsoon and end in the post-monsoon season make up the drainage of the A&N Islands. Only Great Nicobar Island has the rivers of the A&N Islands [2]. These include Galathea, Dogmar, Amrit Kaur, Jubilee, and Alexandra. As a result, the main sources of drinkable water are groundwater and rainwater. Despite sharing a similar physiography and drainage, the climates of the Andaman Islands and Nicobar Islands differ.

Climate: Although the Andaman Islands and Nicobar Islands both have a monsoon climate, there are some distinctions between the two island groupings. The A&N Islands have an area of roughly 890 km2 and are located between latitudes 6o N and 14o N. The A&N Islands' north-south distance has caused the climate on each island to differ. Compared to Nicobar Islands, the Andaman Islands have a more tropical climate. While the Nicobar Islands see rain nearly every month, the Andaman Islands experience more distinct dry and rainy seasons.

Vegetation: The lush vegetation in the A&N Islands is a result of the region's hot and humid climate. The geographic area of the A&N Islands is covered by forests to a greater than 85% extent.10 From the coast to the interior, the islands are covered in forest [3]. Mangroves, littoral forests, and non-littoral forests can all be used to categorize the island's vegetation.

Mangroves encircle the island's coastlines. The mangroves on the A&N Islands reportedly encompass 96,600 acres, according to the Forest Department. The littoral forests, with their long, deeply cracked, white-barked trunk and luxuriant, shady canopy, are located behind the mangroves and on the edge of the sandy beaches. These forests have crowns and branches that face the landward side. This demonstrates how they serve as a windbreaker. The primary food and "bread fruit" pandanus, commonly known as screw-pine, is also present in this region.

Deciduous, semievergreen, and tropical evergreen rainforests are the three types of non-littoral forest. The heart of the islands are covered in semi-evergreen and tropical evergreen forests, while deciduous forests are found on the hillsides [4].11 There are variances between the natural vegetation of the Andaman Islands and the Nicobar Islands despite their similarity. The Nicobar Islands' vegetation resembles that of the Malaysian peninsula and the Indonesian islands, whilst the Andaman Islands' vegetation is comparable to that of Myanmar.

Therefore, it can be stated that the physical environments of the Andaman Islands and Nicobar Islands are not noticeably different from one another. However, both islands have very different sociocultural backgrounds. The cultures of two representative tribes the Great Andamanese of the Andaman Islands and the Nicobarese of the Nicobar Islands express these contrasts. There are explanations for why only these two tribes were chosen from the six indigenous tribes of the A&N Islands.

Motives for Choosing the Best Nicobarese and Andamanese

The A&N Islands are home to six indigenous groups. The Great Andamanese and Nicobarese tribes have been chosen as the respective representative tribes for the Andaman Islands and the Nicobar Islands out of these six. These three tribes were chosen for three different reasons. First, the largest portion of each island's population was represented by these tribes. When the British invaded the Andaman Islands, they came across tribes on various islands, yet these tribes were comparable in terms of appearance and the tools and weapons they utilized.

Since they inhabited the entire archipelago of the Andaman Islands, the British called them Great Andamanese. The British became aware of another tribe once "friendly" contacts with the Great Andamanese were established. This tribe was referred to by the Great Andamanese

as "jarawas," which is Great Andamanese for "the other. The British eventually discovered four tribes that had lived in the Andaman Islands prior to colonization. Great Andamanese, Jarawas, Onges, and Sentinelese were among them. According to British estimations, there were 8000 Great Andamanese in 1858, compared to no more than 600 of the other three combined. Similarly, Shompens made up barely 5% of the population of the Nicobar Islands, where the Nicobarese made up 95% of the total. Secondly, both of these tribes had a large population. The majority of the Andaman Islands were home to the Great Andamanese, who were widely dispersed. The Jarawas, on the other hand, were confined to the interior of Rutland Island and South Andaman Island. Again, the Sentinelese were restricted to the North Sentinel Island, but the Onges only occupied the Little Andaman Islands.

DISCUSSION

Great Andamanese in the Andaman Islands were resistant to colonization and frequently attacked the British settlement. However, "friendly" interactions developed over time. The other three tribes, including the Jarawas, Onges, and Sentinelese, did not communicate with the British and continued to be "hostile" toward them. Similar to this, the British kept "cordial" relations with the Nicobarese in the Nicobar Islands. Due to their shyness, the Shompens hid from the British. They had little interaction with the British. Furthermore, the names Great Andamanese and Nicobarese convey the idea that they were the tribes that best represented the Andaman Islands and the Nicobar Islands, respectively.

The Mighty Andaman

Negritoes are the race that includes the Great Andamanese. They have peppercorn-colored hairs and are dark in color almost black as charcoal. They have broad cheekbones, a broad face, and a broad skull. They have wide eyes that range in color from brown to dark brown and have excellent vision. They have well-built physique despite their low stature (the average height for men is 4 ft 9 in and for women it is 4 ft 5 in): The Andamanese men and young women are not unattractive in appearance; in fact, some of them stand out as particularly attractive due to their beautiful, well-shaped noses, thin lips, small mouths, even white teeth, bright sparkling eyes, and very well-defined proportions. According to Weber's description of the Andamanese, "Andamanese look tiny but elegantly proportioned. Cipriani demonstrated that the Aetas of the Philippines and the Semangs of Malaysia have traits in common with the Great Andamanese. Based on 16 G., New Delhi, Government of India, 1955 to Radcliffe–Brown the Great The Andamanese came to the Andaman Islands through Burma by land or by sea. During the previous ice age, there was possibly a land connection between Burma and the Andaman Islands [5]. Another idea is that they were brought to the island by the north-east monsoons and, without a way to leave, they stayed and dispersed throughout the entire archipelago.

Therefore, the Great Andamanese's likely travel path was from the Philippines to Indonesia, Malaysia, and Myanmar before arriving in the Andaman Islands. He came to the conclusion that the Great Andamanese were the first to reach the Little Andaman coast. Later, it expanded to several locations and went north into the Great Andaman Islands. But as a result of their lack of interaction, these two groups separated and developed their own languages, canoes, crafts, rituals, and hunting gear. The Mongoloid race includes the Nicobarese. Their skin tone ranges from yellowish brown to reddish brown. The eyes are obliquely set, the nose is wide and flat, the cheekbones are prominent, the face is somewhat flat, and the mouth is large. The forehead is well-formed, the lips are normal, and the ears are of medium size. They have a robust build and appear well-built. Men in Nicobar are typically 5 feet 4 inches tall, while women are typically 5 feet. They likely traveled to the Nicobar Islands from Burma, Sumatra, or Indo-China, based on their mongoloid traits. Later DNA studies link the East Asian families to the

Nicobarese. The study of Nicobarese language further supported their connection to South-East Asia. Their language is a member of the Austro-Asiatic Mon-Khmer language family. Consequently, it has been suggested that they may have crossed the Andaman Sea from Burma or may have

Great Andamanese and Nicobarese Social and Cultural Practices: A Comparison

People's social and cultural behaviors are their adaptations to their physical surroundings, which over time grow to define that culture. Although there are numerous similarities between the Great Andamanese and the Nicobarese, the two tribes differ significantly from one another. There were three key commonalities between the Great Andamanese and the Nicobarese before colonialism. First, despite being "sighted" and having their existence known, both the Great Andamanese and the Nicobarese led rather solitary lifestyles with little contact with outsiders. A small percentage of Nicobarese did communicate with the trading ships, but the majority avoided any contact. The islands' meager resources placed restrictions on them. Therefore, both the Great Andamanese and the Nicobarese devised elaborate methods to sustainably utilize the resources in order to conserve them. For instance, the territory belonged to the Great Andamanese and the Nicobarese collectively [6]. Each of the sub-tribes of the Great Andamanese had designated hunting and gathering grounds. The Nicobarese also experienced this. They also shared ownership of the area used for raising coconuts and hunting pigs. Big joint families are common. The smallest group among the Great Andamanese was a nuclear family. However, this family did not live in seclusion. The collective family known as the "sept" was made up of several families, and septs as a whole comprised a tribe. Although some tribes only had one sept, most tribes had three septs. One tribe's septs shared a common hunting site with designated sections for each tribe. Septs were independent units, and cooking was also done communally. The "tuhets" of the Nicobarese are comparable to septs.

An extreme version of a blended family is a tuhet. It does not fit the sociology books' description of a joint family because the members do not share a kitchen or a roof but are nonetheless related through marriage or birth. Each tuhet in a village has designated regions. The simplest economically viable unit in Nicobarese society is the tuhet. The tuhet jointly owns the land and portion of the sea where fishing is practiced. The rights to use the land were granted but the land is not divided among the family. All of the tuhet's members are responsible for taking care of it, and the profits are also divided equally. The tuhet functions as a single unit for social events and other financial requirements. Every hamlet is made up of a number of tuhets, or families. Families and tuhets are both equally numerous in a village. The number of tuhets in Car Nicobar Islands communities vary from 10 to 41. A community typically has 20 tuhets. A tuhet's population can vary as well. A tuhet can contain two families or thirty families. A tuhet divides within itself if it becomes too huge [7].

Nicobarese and Great Andamanese Differences

The Great Andamanese and Nicobarese are distinctly different from one another in five areas in addition to their differences in race. First, the Nicobarese practiced horticulture whereas the Great Andamanese were hunters and gatherers [8]. The Great Andamanese spent their time gathering food such as roots, fruits, and honey. For fishing, they went to the sea or creeks, and for hunting, they went into the woods. Wood, stone, and iron that were taken from the stranded ships were used to make the hunting and gathering tools. On the other side, the Nicobarese are gardeners. The production of pigs and coconuts are essential to the Nicobarese people's economy. In addition to coconut, the Nicobarese also grew vegetables such as pandauns, yam, tapioca, sweet potato, banana, and papaya. They traded with ships that stopped to replenish their food and water supplies during the pre-colonial era. In exchange for clothing, iron, and

areca nuts, raw and dry coconuts were Rice, tobacco, utensils, a knife, pottery, glassware, ornaments made of silver and white metal, sugar, camphor, wooden boxes, and other necessities. In some cases, traders would also exchange edible bird's nest, split cane, beetle nuts, trepan, ambergris, and tortoise shell. Coconuts were traded for goods and services [9]. The prices of the goods were set in terms of the quantity of coconuts. The product had to be delivered upfront, and the foreign traders had to collect the value from the trees later. The traders themselves had to carry the nuts down, prepare the copra, and transport it. Only the total was preserved by the Nicobarese.

Second, there were lifestyle differences between the Nicobarese and the Great Andamanese. The Nicobarese lived in fixed communities, but the Great Andamanese were nomads. The location of dwelling served as a dividing line among the Great Andamanese. There were the erem-taga, or woodland dwellers, and the aryoto, or seashore people. Being coastal dwellers, the aryotos were more reliant on the sea than on the forests, whereas for the eremtagas, the forest served as their primary food supply. The erem-tagas were better at hunting and gathering foraged goods, while the aryotos were stronger swimmers and divers. Because they lived around the coast and had to move with the shifting wind patterns, the aryotos were more mobile than the erem-tagas. When the resources in their hunting grounds ran out, the erem-tagas also moved. The Nicobarese lived in permanent communities on the beaches of the islands, in contrast to the Great Andamanese.

The Nicobarese inhabited permanent settlements that were quite near to the sea. The villages were visible from a distance. There were coconut tree groves all around it. The Nicobar Islands' communities were organized in a linear manner, and each one had a distinct structure. The lack of resources has also led to certain disparities between the Nicobarese and the Great Andamanese. To restore the depleted resources, the Great Andamanese, for instance, lived a nomadic lifestyle centered on hunting and gathering.

Again, because the Nicobar Islands are smaller than the Andaman Islands, the Nicobarese were unable to maintain a nomadic lifestyle because doing so would have resulted in the entire depletion of the available resources [10]. They therefore decided to reside in permanent settlements and raise pigs and coconuts. The Nicobar archipelago's limited size has contributed to the islands' dependency. Since none of the islands could support themselves, they all remained connected.

The islands' interactions with people from other islands were significantly influenced by their geographic location. The Nicobar Islands are on a commerce route, but the Andaman Islands are isolated. The Nicobarese were familiar with the commercial ships due to their proximity to the Malacca Strait. These commerce ships became the Nicobarese's source of exotic goods, including rice, tobacco, and clothing. Nicobarese were consequently cordial with the trading vessels. Although the Great Andamanese and the Nicobarese were similar in many ways, their treatment of outsiders proved to be a deciding factor in their fate [11].

CONCLUSION

The discussion that has come before suggests that the Great Andamanese and the Nicobarese have similarities and clear differences. The lack of resources was the primary factor in the similarities, although the islands' geographic location was a significant factor in the differences. The tribe made an effort to wisely manage its limited resources by adopting a system of communal land ownership, big joint families, and adoption. As a result, everyone had access to the main resource, which was land, which prevented hoarding. Similarly, the entire joint family shared the dinner. In addition to preventing overuse of the scarce resources, this method also reduced waste. Adoption was a novel way for tribes to maintain harmonious relations with

one another. Families always value their children; therefore, they happily donated them to the neighboring tribes. As a result, the tribes had mutually agreed to refrain from attacking one another after becoming one family as a result of adoption.

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CHAPTER 6

SOIL DISTRIBUTION IN INDIA: A DETAILED DISCUSSION

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ABSTRACT:

Before the emergence of human civilization, soils were developed. In light of this, a description of soils in the past and present geological periods creates fascinating scientific data for a variety of stakeholders, including agricultural scientists, sedimentary geologists, geoarcheologists, environmental specialists, and paleontologists. As indicated by the country's increasing self-sufficiency in food production and food supplies since independence, Indian soils, especially those that have experienced extensive weathering in humid tropical conditions, have the potential to be productive in terms of food production. In order to use soil for sustained production, it is crucial to have up-to-date understanding about the resource's potential, constraints, current application, and management techniques. Due of the wide variety of soils, India is sometimes referred to as a land of paradoxes. High mountains, snow fields, glaciers, dense forests, oceans washing long coasts on the Peninsula, a range of geological formations, a varied temperature, a varied topography, and a varied relief have all contributed to the development of a variety of physiographic features. The climate ranges from arctic cold to tropical heat, and rainfall ranges from a scant few centimeters in desert regions to several hundred centimeters per year in certain other wet regions. Due to these circumstances, there are towering plateaus, relict stump hills, shallow open valleys, rolling uplands, rich plains, marshy lowlands, and desolate, arid deserts. Compared to other countries of comparable size in the world, India has a greater range of soils due to its diverse natural settings. It is understandable that the agriculturists of ancient India, who were dispersed across the nation and whose livelihood depended on agriculture, were aware of the nature of soils and how it related to the production of certain crops with high economic returns.

KEYWORDS:

Edaphology, Ferruginous Soils, Physiographic Features, Soil Taxonomy, Tropical Heat.

INTRODUCTION

The soils throughout the world experienced climatic changes as a result of the Quaternary's global climatic events, particularly during the most recent post-glacial period. The Quaternary has seen several climate shifts During the Holocene, the climate in rainfed parts of India evolved from humid to semi-arid. Under SAT conditions, it has been noted that India's major soil types are changing from sandy to calcareous and sodic, which affects the physical and chemical characteristics of soils. Regressive pedogenesis results in such alterations, which lessen the likelihood of good crop growth. Vertisols are found in weathered Deccan basalt and also occur in humid tropic (HT), sub-humid moist (SHm), sub-humid dry (SHd), semi-arid moist (SAm), semi-arid dry (SAd), and arid environments in the Indian Peninsula. This indicates that basaltic parent materials have an influence on the formation of similar soils under various climatic conditions. Despite being classified under the same soil order (Vertisols) (Soil Survey Staff 2014), these soils have different morphological and chemical characteristics. In HT, SHm, SHd, and SAm soils, cracks > 0.5 cm wide spread down the zones of sphenoid and wedge-shaped peds with smooth or slickensides surfaces. But only in SAd and dry soils do fissures cut through these zones [1]. A decrease in mean annual rainfall (MAR) results in the

creation of calcareous and alkaline soils, according to soil responses and CaCO3 content. As a result, soil properties fluctuate, forcing their classification into several groups under the soil taxonomy. The fact that the soils of HT are Typic Haplusterts (typical black soils), SHm and SHd are Typic/Udic Haplusterts, and SAd is Sodic Haplusterts and Sodic Calciusterts (degraded black soils with high sodicity and lime) provides evidence of this. These illustrations aid in understanding how soils in tropical and subtropical areas of India and worldwide bear the marks of climate change. Given that soils have an exceptional memory and meticulously record historical episodes, it is important to precisely group soils using soil taxonomy in order to understand how the climate behaves and changes. Black soil conditions in climates with humid tropical (HT) and semi-arid tropical (SAT) zones. Soil survey, mapping, and classification, along with the other relevant information on geomorphology, soil mineralogy, and climate, are used to understand the genesis of soil and its persistence under the humid tropical climate (HTC) that has prevailed in the Western Ghats since the early Tertiary. The valleys' deep black soils develop as a result of

Indian Agriculture Situation: Due to the base-rich zeolites found in amygdaloidal basalt, soil to the progressive landscape reduction process and remain in HTC. The understanding of zeolites' function in soils offers a check on the logic of theories explaining how soils originate in HTC. In addition, zeolites keep soils from losing productivity even in environments with heavy leaching. A novel soil genesis pathway that highlights the inadequacy of the current conceptual models for the formation and persistence of tropical Vertisols for millions of years in unfavorable HT climatic environments could be built by analyzing the current landform feature of the Western Ghats and utilizing the high resolution clay mineralogical data [2]. The smectitic parent materials are the actual foundation of black soils (Vertisols and their companions). Smectites, however, are transient in HTC. Because of the existence of the rare mineral known as Ca-zeolites, smectite has been retained in tropical Vertisols of the Western Ghats. These minerals help to preserve the soil and environment in the breathtaking Western Ghats.

Clay illuviation in HT and SAT climates on ferruginous red soils (Alfisols):

Alfisols, or ferruginous red soils, are widespread in India's peninsular and extra-peninsular regions. Their chemical and physical characteristics are not the same, though. Alfisols on Peninsular gneiss is created on extremely old landscapes and have a well-developed argillic (Bt) horizon that is immediately above it and has a clay concentration of >30%. Clay distribution in the Bt3 or Bt4 layers at a depth of around 60–70 cm displays either an ascending or descending trend. Due to soil erosion or plowing, the thin Ap horizon is a disordered horizon. In such Alfisols, the depth distribution of clay exhibits an upward tendency if this horizon is disregarded, a characteristic typically observed in a juvenile residual soil profile. These Alfisols, on the other hand, are ancient soils because they were created on the earth's old rock system. The illuviation of clay particles is what leads to the deposition of clay in the subsurface [3].

The humid past saw the activity of this process. According to the current semi-arid climate of this region and the properties of the soil, these soils have a connection to the previous event with considerable rainfall. Soil profile truncation generated during the previous humid tropical environment is clearly indicated by the deep distribution of clay. In many areas of southern and western India, this landscape reduction process has created a distinctive spatially associated red-black soil complex that represents typical geomorphological features in the country's semi-arid tracts of today Clay content rises with depth in various Alfisols of the IGP. These soils are rather well-developed because the ratio of the clay content in the clay-rich Bt layer to that of the A horizon is >1.2. In these soils, the amount of clay rises with depth to a maximum and

then falls until it stabilizes or exhibits a decreasing tendency. With a 10X lens, clay skins may usually be seen in the field as a result of illuviation of clay particles. The Situation with Indian Soils In the humid tropical climate (HTC), 19 Alfisols/Ultisols are primarily clayey, and clay skins are challenging to distinguish in the field in northeastern India. Clay skins, however, provide evidence of clay transport and buildup in the soils of the Western Ghats. In Arunachal Pradesh, ultisols demonstrate consistency of parent materials. These soils are fairly well developed, according to the clay distribution as a function of depth.

DISCUSSION

According to the model, gibbsite is a byproduct of a previous weathering cycle with neutral to alkaline pedo-chemical conditions [4]. Since it was thought to have developed from kaolinite, gibbsite has long been regarded as an index mineral indicating the advanced stages of soil weathering. The desilication process is only active above a pH of 8.5, therefore such transformation is unlikely in acidic soil conditions Gibbsite is found in the Ultisols of the Shillong plateau in Meghalaya, and evidence suggests that it was created in an alkaline pedo-environment The model used to explain the creation of gibbsite highlights two key facts: (i) gibbsite is still extant as a byproduct of an earlier alkaline pedo-chemical environment, and (ii) it can still form even in the presence of significant amounts of 2:1 minerals. disproves the anti-Gibbsite effect theory Therefore, the presence of gibbsite in these soils should not be viewed as indisputable evidence of extensive soil weathering. Given that gibbsite is listed as a mineral with a very high weathering index by Jackson's weathering index (WI 11), this finding assumes significance. Although Ultisols may fall under the gibbsitic/allitic mineralogy class in soil taxonomy due to the presence of gibbsite (Soil Survey Staff 2014), this categorization does not create a connection between the modern pedogenesis, mineralogy, usage, and management of these soils. Desilication and the conversion of 2:1 layer silicates to kaolinite and then gibbsite are not included in the current pedogenesis of Ultisols of Kerala, which are regarded as the international standard for laterite [5]. The result suggests that it may be challenging to reconcile the chemical change of ultisols to oxisols over time as predicted by conceptual models of tropical soil genesis One instance of natural chemical breakdown is regressive pedogenesis.

The SAT's soils are often calcareous and frequently sodic, either at the subsurface levels or over the entire depth of the soil In the main soils of India (alluvial soils of the IGP, ferruginous soils, and shrink-swell soils) under semi-arid tropics (SAT), pedogenic CaCO3 (PC), which can only be distinguished from pedorelict CaCO3 (NPC) by soil thin section studies, is very prevalent. According to Rabenhorst et al. (1984), the principal mechanism for PC precipitation in SAT conditions is water loss through evapo-transpiration. However, temperature also affects how much water moves through the soil. In reality, as indicated by the steady rise in PC in Vertisols from humid to arid locations, this is apparent in soils of the dry (sub-humid to arid) parts of India. Sodicity in soils develops concurrently with PC formation. Due to their sandy textural class, which promotes higher leaching of bicarbonates, desert soils have not yet developed sodicity, and PC is typically found at larger depths. As a result of the delayed leaching of bicarbonates in soils with loamy and clayey textures, both PC and sodicity develop in upper strata. Ferruginous soils (Alfisols) of southern India, which contain around 30% clay and are dominated by 2:1 expanding clay minerals, are a good example of these pedogenetic processes. These soils evolved in a humid tropical climate during the pre-Pliocene. Due to the effects of the current semi-arid climate, PC development is seen in these Alfisols [6]. They are therefore calcareous rather than ferruginous like wet tropical soils.

Only when the soil solution is supersaturated with $CaCO_3$ in semi-arid conditions do lubinites, which are mostly concentrated PCs, form in such soils). As a result, the texture plays a significant influence in the buildup of carbonates in soils in addition to the climate's aridity.

The development of PC in soils as a result of the buildup of soil inorganic carbon (SIC) reduces soil productivity. The pH is raised as a result of PC production in arid climates, as well as the relative abundance of Na+ ions in both soil exchange sites and solution [7]. The Na^+ ions then contribute to the dispersion of the fine clay particles. The development of PC produces a chemical environment that is favorable for the deflocculation of clays that translocate down the depth of soils. As a result, the development of PC and the illuviation of clay are two contemporaneous pedogenetic phenomena that occur simultaneously. This causes a rise in the sodium concentration as well as an increase in the sodium adsorption ratio (SAR), the exchangeable sodium percentage (ESP), and the soil pH with depth. During the dry climates of the Holocene, these pedogenetic processes have continued to serve as a pedogenic threshold. Accordingly, the development of PC is a fundamental process of natural degradation brought on by tectonic-climate-related processes. This process demonstrates regressive pedogenesis wherein C is immobilized in an inaccessible form as a result of the production of PC and concurrent development of ESP in subsoils [8]. The rates of PC production for alluvial, shrink-swell, and red ferruginous soils in semi-arid climates were calculated to be 129, 38, and 30 kg $CaCO_3$ ha^{-1} yr^{-1}, respectively.

Validation of conceptual models for the genesis of tropical soil

On the zeolitic Deccan basalt areas under HT (humid tropical) climate, Mollisols, Alfisols, and Vertisols are the members of the Mollisols-Alfisols-Vertisols association that have persisted since the early Tertiary. At the end of the Cretaceous and into the Tertiary, smectite, the earliest weathering product of the Deccan basalt, was converted to kaolin (KI-HIS, kaolinitehydroxy interlayered smectite) by HT weathering. Strongly acidic Ultisols are paired with moderately acidic Alfisols on sedimentary and gneissic rocks in NEH. Neutral to slightly alkaline Mollisols are coupled with slightly acidic Alfisols in the Andaman and Nicobar Islands on calcareous/micaceous sandstones and lime stones. The abundance of kaolin and other hydroxy interlayered clay minerals in the soils of the zeolitic Deccan State of Indian Soils 23 basalt, gneiss, sedimentary deposits, and lime stones, which represent Ultisols, Alfisols, and Mollisols, suggests that the presence of Ca-bearing weatherable minerals in the parent materials of the soil under forest vegetation has affected the weathering rate and had a significant impact on the nature of the soil silicate clay minerals

The HT climate of the Western Ghats, Satpura Range, NEH regions, and Andaman and Nicober Islands provided a weathering environment with a combination of high temperature and sufficient moisture that should have nullified the effect of parent rock composition in millions of years, resulting in kaolinitic and/or oxidic mineral assemblages consistent with either residua and haplosoil models of tropical soil formation such as in Ult Instead, the kaolin-hydroxy interstratified smectite minerals (KI-HIS), which are representative of Mollisols, Alfisols, and Vertisols, are found in the soils of the zeolitic Deccan basalt, gneissic, and sedimentary rock formations [9]. As a result, the development and survival of Mollisols, Alfisols, and Vertisols show that the concept of a steady state is relevant in an open system like soil and that Jenny's state factor equation is still accurate [10]. The understanding of the role of basic minerals, such as Ca-zeolites, in the persistence of soils not only offers a deductive check on the inductive reasoning regarding the formation of soil in the HT climate, but also sheds light on the role of basic minerals in preventing loss of soil productivity even in a leaching environment with high intensity. In India's principal soils (alluvial, black, and ferruginous soils), micas, which are mostly concentrated in the silt and clay fractions, are the main K-bearing minerals.

Despite this advantageous endowment, many of these soils have shown aberrant crop response to K fertilizers. The existence of muscovite and biotite in soils of the Brahmaputra alluvium (BA), the IGP, as well as in black soils, was confirmed by a petrographic analysis of sand

fractions of the country's most significant soils. In ferruginous soils, muscovite particles were extremely uncommon. Muscovite was more prevalent than biotite in the soils of the IGP and BA. Black soils had lower levels of micas than the other two soils, and biotite predominated over muscovite. Regardless of the type of soil, biotite generally appeared as thick particles with varying degrees of layer separation, according to the SEM analysis of micas. Due to the replacement of interlayer K in biotite mica, these minerals weathered through layer separations and bending at the edges, displaying the layer separation, to produce a vermiculite ring around the particles. A general absence of interlayer opening, however, shows that the replacement of interlayer K in muscovite was not significant. However, noted weak to moderate layer separation at the muscovite border in several soils and hypothesized that this was caused by alteration prior to pedogenesis. Since soil fine-grained micas are not 'perfect' in terms of structure and content, it was anticipated that the release of K from them would differ. As established, zones within a particle may include layer minerals at various phases of growth [11]. The conclusion is therefore mostly theoretical as many of the hypothesized correlations between K release and micas are based on findings from specimen micas rather than soil micas [12]. The X-ray intensity ratio of the peak heights of the 001 and 002 basal reflections of mica has been used thus far in attempts to emphasize the precise nature of soil mica in the silt and clay fractions of Indian soils. In the silt and clay fractions of the main soils in India, the ratio is greater than unity.

However, this ratio is almost exactly one in soils of Brahmaputra alluvium (BA) and black soils in the basaltic 26 State of Indian Agriculture: Soil alluvium, especially in their clay fractions. In reality, the ratio >1 indicates the existence of both muscovite and biotite minerals as well as the muscovitic nature of mica The ratio would have been very near to one if only muscovite minerals were present When these two micas are combined, both will increase the intensity of the 1.0 nm reflections, whilst biotite will have little to no effect on the 0.5 nm reflection, raising the intensity ratio of these reflections. This criterion states that the silt fractions of the IGP and BA alluvial soils, the ferruginous and black soils, as well as the clay fractions of the IGP and ferruginous soils, all include both muscovite and biotite. However, the BA and black soils' clay fractions have a stronger muscovitic personality when it comes to K release and accessible K status, muscovite enrichment of soils is not advantageous. This is demonstrated by the lower rate of K release from black soils and soils of BA as compared to the much higher rate of K release from soils of IGP and ferruginous soils. The exchangeable potassium percentage (EPP) of the majority of IGP soils ranges from 3 to 8% for vertisols (BS), it ranges from 1 to 2% and for ferruginous soils (FS), it ranges from 3 to 4 indicating that the majority of Indian soils do not adsorb or fix K.

The literature frequently notes that while smectites and kaolinites have low capacities, micas, hydrous micas, and vermiculites have good adsorption/fixation characteristics. It is challenging to comprehend how mica can adsorb or fix more K, though, if mica is thought of as a mineral that does not expand when saturated with divalent cations. Understanding the interlayer charge density of the mineral is crucial because K fixation is governed by the negative charge of the minerals. Kaolinites play no role in such a process, whereas vermiculites will change into mica as a result of K-induced layer contraction. Smectites would not have this property since they do not preferentially adsorb K unless the charge density is large and because their layer charge is too low. Some soil smectites are better able to fix K than many specimens' type smectites. Vermiculite and beidellite clays were the best K fixers, and montmorillonitic clays had negligible fixing. The fine clay fractions in BS have the largest concentration of smectite, which increases as particle size decreases. Despite this, fine clay smectites do not take part in the adsorption or fixing of additional K, as shown by the comparably low amount of adsorbed K in these materials [13].

CONCLUSION

To track the changes in soil attributes brought on by anthropogenic activities and climate change, it is important to encourage the top soil institutes to conduct research and collect soil data in the benchmark (BM) soils on a regular basis (let's say, every 10 years). Such time-scale data will aid system modelers in anticipating future changes so that remedial action can be performed to keep soils sustainable. For increased production. This will supplement the three layers of temporal datasets on soils that have already been created for the chosen BM soils. The focus should be on (i) soil genesis and classification: soil parameters affecting crop performance must be linked with soil maps and appropriate soil grouping that need to be reflected in the mapping legend, (ii) linking pedology and edaphology including soil microbiology and biology, and (iii) research on benchmark soils to bring our soil datasets on a single platform for national and international reference (vi) way of recording study findings: genuinely and religiously for posterity, and (vii) SAUs and research institutions need to reward professors and students; in this day and age of a dynamic world, adequate fellowships for students and training for trainers are essential. To join the international academic and scientific team, we must be given adequate funding by the relevant authority in order to recruit more qualified students, scientists, and professors.

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CHAPTER 7

CLASSIFICATION OF INDIA'S FORESTS USING REMOTE SENSING AND GIS

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ABSTRACT:

India is a mega-diverse nation with a diverse topography, large range of climatic conditions, and vegetation varieties. Based on data from the multi-season IRS Resourcesat-2 Advanced Wide Field Sensor (AWiFS), the present study has categorized the different types of forests in India. There are 14 different types of forests and seven different types of scrub identified in the study's 29 land use/land cover groups. For the classification of different forest types, a hybrid classification strategy has been adopted. Based on the ecological rule bases used by Champion and Seth's concept of Indian forest types, the classification of vegetation has been done. The current classification system has been contrasted with the existing land cover products at the international and national levels. The percentage of India's entire geographic area covered by natural vegetation was calculated to be 29.36%. Tropical dry deciduous and tropical moist deciduous are the two main types of forests found in India. Tropical moist deciduous woods take up 2,07,649 km2 (33.19%) of the total forest cover, followed by 2,17,713 km^2 (34.8%) of tropical dry deciduous forests, 48,295 km^2 (7.72%) of tropical semi-evergreen forests, and 47,192 km^2 (7.54%) of tropical wet evergreen forests. Based on inputs crucial to establishing the various categories of vegetation and forest types, the study has produced extensive maps of vegetation cover and forest kinds. For investigations on changes in different forest types, carbon stocks, climate-vegetation modeling, and biogeochemical cycles, this spatially explicit database will be very helpful.

KEYWORDS:

Advanced Wide Field Sensor, Biogeochemical Cycles, Climate-Vegetation Modeling, Remote Sensing, Tropical Semi-Evergreen Forests.

INTRODUCTION

Understanding carbon stocks, biodiversity, the sustainable use of natural resources, and climatic change all depend on how vegetation is classified. The many vegetation types take into account all of the structural and functional characteristics of vegetation in connection to the local and regional climate, necessitating the incorporation of several inputs that are also spatially explicit [1]. The classification of vegetation is more complicated despite the fact that biological systems are organized hierarchically from the molecular to the ecosystem level. This is due to the variety in distribution of species, communities, and ecosystems. The system of life zones was the first global classification system for biological kinds that could be predicted from climate. They suggested physiognomy, or the predominance of particular growth forms like trees, shrubs, and grasses, as the fundamental defining factor for identifying a vegetation type. The integration of floristic composition with physiognomy and environmental traits was then proposed by observational size, i.e., the scale at which it is possible to assess the relative regularity and distinctness.

Therefore, this spatial scale will range from a few m2 to several thousand m^2 depending on the vegetation's structure. There are various meanings of "forest" used around the world depending

on local conditions, national laws, and environmental and commercial concerns. According to a survey, there are more than 800 distinct definitions of forests used throughout the world. "Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10%, or trees able to reach these thresholds in situ," according to FAO (2010), is considered to be a forest. The land area with trees that is primarily used for agricultural or urban land use is not included in the aforementioned criteria [2].

According to the United Nations Framework Convention on Climate Change (2001), thresholds include 0.05–1.0 ha of forested area, 10–30% tree canopy coverage, and 2- 5 m of mature tree height. The concept of forest also includes young natural stands and all plantations that have a canopy cover of 10–30% or tree heights of 2–5 meters. In the study by Hansen et al. (2013), the term "forest" refers to the tree cover, based on which the extent, loss, and gain of the global tree cover from 2000 to 2012 was mapped. A forest is often described as a region with much greater levels of canopy closure in many nations, such as >20% in Australia and China, >30% in Russia, and >60% in South Africa.

According to the Forest Survey of India (FSI), "all lands more than one hectare in area, with a tree canopy density of > 10 percent, regardless of ownership and legal status" fall under the definition of forest cover. Thus, the FSI definition of forest cover includes all types of land, regardless of predominant land use, and includes all tree species (both native and alien), as well as all areas meeting the aforementioned criteria, regardless of whether they are forests, public parks, or institutional land (FSI, 2011). It also makes no distinction between the origin of tree crops (whether natural or planted), or tree species. By incorporating numerous plantation types like rubber, Casuarina, Eucalyptus, poplar, coffee, tea, Acacia, coconut, areca-nut, cashew, palm trees, and orchards of mango, orange, and apple, India may be overestimating the amount of forest cover [3].

As a result, the UNFCCC REDD+ discussions and the conservation of native biodiversity depend on the application of natural forest definition in forest cover estimation. Accordingly, the current study defines a forest as an area of more than one hectare that is dominated by native tree species, has a minimum stand height of five meters, and has an overstorey canopy cover of at least ten percent. India is a mega-biodiversity nation that sits at the intersection of the Indo-Malayan, Eurasian, and Afro-tropical biogeographic regions. The population of the nation, which makes up 17.5% of the world's total, is the second largest in the globe. It is the second largest country in Asia and the seventh largest country in the world by area. India has a varied vegetation that includes 17,500 species of flowering plants over its 32,87,263 km2 of land.

The diversity of its geographical and climatic regimes is thought to be responsible for its rich vegetation and great biodiversity. However, the country's rich biodiversity is currently under intense anthropogenic threat. Reddy et al. (2013b) evaluated the spatial patterns of forest fragmentation and the impact of deforestation across the country between 1975 and 2005. Based on spatial data of changing forest cover, changing forest canopy cover, changing forest fragmentation, changing forest fires, and changing areas of biological invasion, studies have shown a significant loss of biodiversity at the ecosystem level (Reddy et al. 2014). India had a population of 238.4 million in 1901; by 2011, that number has more than quadrupled to 1210 million.

In India, four different types of climatic zones have been recognized based on temperature (Champion and Seth, 1968). Tropical zones are those with mean annual temperatures of >240°C, followed by subtropical zones (17–240°C), temperate zones (7–170°C), and alpine zones (70°C). India has regions with the lowest rainfall on earth and regions with the highest

rainfall on earth. From sea level to the tallest mountain ranges in the world, the altitude varies [4]. From the Himalayas in the north to the Western Ghats in the south, from the thorn vegetation of the north-west to the wet evergreen forest of north-east India, the vegetation types vary.

They employed a variety of characteristics, such as physiognomy, structure, phenology, function, plant association, flora, climate, geography, soil, and biotic variables, to classify the different types of forests in India. Since then, Indian scholars and foresters have made extensive use of the program. Based on the relationship of species and bioclimatic. Authors identified 42 different forest types in India. These earlier attempts to categorize Indian forests have carefully employed field data to determine patterns of vegetation kinds, but they lack spatially specific boundaries [5].

DISCUSSION

First off, while digital methods of forest type separation may produce more repeatable findings, they still require human validation before being accepted. Second, because there is a high degree of vegetation variety in a particular spatial location, there may be more class overlaps, which requires a knowledge of the spectral response pattern and the integration of visual critical features for the interpretation of forest types Using handheld GPS, ground truth data has been gathered from all of the vegetation types that cover the plains and hilltops. Ten biogeographic zones, including the Himalayas, are recognized by the biogeographic categorization of India. However, the Himalayas are divided into two biogeographic zones for the sake of the current study: the Western Himalayas and the Eastern Himalayas. In light of the floristic distinctiveness, geophysical conditions, distinct geological beginnings, and sweep of the AWiFS scene, the biogeographic zones were employed as wide first level strata. The Normalized Difference Vegetation Index (NDVI) and supervised maximum likelihood classification for forest classes based on phenological variations (i.e. peak growth and leaf fall) and signature separability were applied separately to each zone after extracting the False Colour Composite image [6]. Classification of non-forest classes was done using a maximum likelihood classifier. Scrub, grasslands, and savanna signatures in the spectral discrimination study overlapped because of the low spectral separability. In order to map grasslands and savanna, a hybrid categorization technique was used. By employing Resourcesat-2 AWiFS, the National Remote Sensing Centre developed spatial data of agricultural land, orchards, settlements, and water bodies that we have incorporated (NRSC, 2013). The 3x3 majority filter was used to smooth the output of the thematic raster. Visual post-classification refining was carried out based on field data and extremely high-resolution open access pictures found on Bhuvan and Google. To match the spatial resolution of AWiFS, all digital data related to climate and elevation were resampled to 56m.

Evaluation of accuracy

In general, an accuracy assessment is necessary for every land cover classification. The classification accuracy is influenced by a number of variables. The accuracy of classification is mostly dependent on sampling theory, but practical issues with resources and accessibility limit what is desired. The kappa coefficient and error matrix (confusion matrix) are now commonly used to measure classification accuracy. Error matrices evaluate the correspondence between known reference data (ground truth) and the related outcomes of the classification operation, class by class. The number of correctly identified points for each class was divided by either the total number of points in the corresponding column (producer' accuracy) or row (user' accuracy) to determine the individual class accuracy. The entire number of correctly identified points (i.e., the sum of the elements along the principal diagonal) was divided by the

total number of reference points to calculate overall accuracy [7]. To determine overall categorization accuracy, a total of 8504 samples from diverse vegetation types and land use/land cover throughout India were randomly selected by the National Remote Sensing Centre and collaborators for the current study. A discrete multivariate technique called kappa analysis is employed in accuracy evaluation. The real agreement between reference data and classified data and the chance agreement between reference data and classified data are measured using kappa statistics

A system of classification

Vegetation and land use/land cover classifications in India have been identified by the study. The fundamental classification aims to distinguish between uncultivated and managed systems (croplands, plantations, and orchards), bare ground, water bodies, snow, and settlements, and natural vegetation cover. Forests, scrub, savanna, and grasslands were used to categorize the natural vegetation cover. Four criteria have been used to categorize natural forest vegetation: (1) life form (predominance of tree cover), (2) forest cover (>10% canopy cover), (3) leaf type (broad leaved or needle leaved), and (4) leaf longevity/phenology (evergreen or deciduous).

According to Champion and Seth's classification (1968) approach, the forest class is further separated into climatically driven forest ecosystems [8]. The subsequent levels of classification within the category of "forest class" are based on phenology, followed by biogeography, elevation, and field data. These levels include 14 different forest types, including tropical moist deciduous forest, tropical dry deciduous forest, tropical moist evergreen forest, tropical thorn forest, and subtropical pine forest. The names of each of the 14 forest type classes identifiedare used to describe each class. The classification system used in the current study is exactly in line with that used by Champion and Seth. Similar to this, the study's classifications of vegetation and land use/land cover will make it easier to link them to various international and national categorization schemes. Wet evergreen forest and temperate woodland make up the flora. These woods, which are only found in the lower slopes of the Himalayas, North East, Aravallis, and Western Ghats, are luxuriant with evergreen species. In the Western Ghats, Lauraceae species predominate. The shifting farming and forest fires in the lower Eastern Himalayan mountains have had a significant negative impact on the forests. These forests are abundant in creepers, bamboos, and orchids.

RS These areas are depicted in the FCC image as having a reddish or dark brown tone with a medium to rough texture, and in the months of April and May, a relatively low NDVI value was discovered, indicating the leaf fall of a few tree species. Dry evergreen subtropical forest: It features prickly species of shrubs and small-leaved evergreen trees. More than 75% of trees maintain their greenness all year long. Never is a canopy without any green vegetation. Normally, there is a protracted hot, dry season in forests. Typically, it has trees with gleaming, varnished-looking foliage. Mostly shrubby growth is present. During the monsoon, annual grasses and herbs are frequently visible. These forests can be found up to 1500 meters above sea level in the Shivalik highlands and Himalayan foothills. These locations are depicted in red on the FCC image with a medium roughness [9].

Temperate montane forest: The woodland is closed and evergreen. These forests can be found at elevations of around 1500 meters or higher in the upper hills of the Eastern Himalayas, North East, and Western Ghats (Nilgiris, Palnis, Anamalais, and Tirunelveli hills). Such forests can be found in places in the more protected areas on the gently sloping grasslands of the Western Ghats, also referred to as "shola." Conifers are not present. The girth and tops of trees branch out greatly [10]. The majority of trees are only 15 meters tall. When the leaves are tender, they are coriaceous and red. Mosses, ferns, and epiphytes are thickly attached to the branches.

Climbers made of wood are also frequent. These locations are depicted in the FCC image with a medium to rough texture and a dark brown tone. Evergreen broadleaved trees predominate in tropical semi-evergreen forests, which are forested environments. More than 75% of trees are continuously green. There is always green foliage in the canopy.

The forest is primarily dense and contains a variety of wet evergreen and moist deciduous tree species. There are several epiphytes and climbers. In all seasons, the FCC image depicts these forests as having a brilliant red tone or a pinkish red tone with a medium to rough texture. These woods are located near tropical moist tracts of riverine vegetation as well as tropical moist evergreen or moist deciduous forests, depending on the location. In April and May, the NDVI was low, and in November and December, it was high.

Forested places where deciduous broadleaf trees predominate: a tropical moist deciduous forest. The type includes a few evergreens and seasonal tree communities with an annual cycle of leaf-on and leaf-off seasons. In late May or early June, leaf flushing begins in tropical moist deciduous forests. The trees frequently have branching trunks and roots to firmly anchor them to the ground, and they typically create irregular top storey [11]. The dry season is when the majority of the higher trees loses their leaves. Evergreen trees and plants predominantly occupy the lower story. In comparison to semi-evergreen and moist evergreen woods, the bark of the trees is typically thicker and rougher. Canes, bamboos, and epiphytes are confined to particular spots. Climbers are everywhere. In contrast to mainland India, the Andaman Islands' forests have a very different species composition, climate, and topography. All of India has moist deciduous forests, with the exception of Rajasthan and the Trans-Himalayas. In green season images, FCC picture characteristics have a brilliant red to brown-tinged red tone with a rough or medium texture, while in dry season images, they have a mottled black tone with a medium or smooth texture. Formation typically extends to the end of the forest boundaries in certain places and is found on the periphery of core semi-evergreen regions. Moist deciduous forests make up the majority of the vegetative system whenever they are found close to dry deciduous forests. In March and April, the NDVI was determined to be low [12].

Dry deciduous tropical forest: Deciduous species symbolize the canopy. From February to May, these forests lose all of their leaves, and the soil is primarily visible for one to four months. Typically, the trees' canopy does not rise higher than 20 meters [13]. The tree species' bark is more coarse and thick. In comparison to evergreen, semi-evergreen, and moist deciduous woods, there are less species. There are no canes or palms. Ferns and epiphytes are extremely uncommon. There are not many climbers. Herbaceous plants are fairly widespread. In drier regions of India, one can find dry deciduous forests. Dry deciduous forests appear dark red in tone and rough texture on FCC satellite images taken during the green season, but during the dry season, the lands take on a greenish shade with little sign of leaf. This system is distinguished by background undergrowth that is dry and frequently burned. In the dry season, it's typical to find these woods contiguous over significant areas, usually interspersed with starkly different linear riverine forests. The NDVI was high from mid-October to mid-November.

Tropical thorn forest: An open, low forest with a predominance of hardwood species. The trees don't get much taller than 10 meters. Acacia species are widespread in these woods. Few people climb. Weedy species that enjoy the sun predominate. This kind can be found in the semi-arid regions of the Deccan, Gangetic Plains, and Indian Desert. In the wet season, it appears rough with a light to dark red tone on the FCC image, while in the dry season, the sections take on a greenish tint with no sign of foliage. In September and October, the NDVI value was determined to be high. Subtropical Pine Forest: Forested places where evergreen conifers predominate. It is essentially a pine-dominated association that is heavily impacted by

recurrent fires. There aren't many shrubs, but there are no climbers or bamboos [14]. Herbs that grow annually and in bulbs are typical. The steep, dry slopes of the Western, Eastern, and North Eastern Himalayas all have pine trees. In all seasons, the FCC image depicts these forests as being brownish red or maroon in color with a medium to rough texture [15]. In this forest type, may showed the lowest NDVI.

CONCLUSION

Using remote sensing data, the current work has made an effort to map various land use and land cover classes, with an emphasis on the varied types of forests found in India. In order to align with Champion and Seth') categorization of national-level forest types and currently accessible worldwide classification schemes, it has established a strong, complete, and mutually exclusive (rather than numerous mixed classes) classification scheme. This spatial information is highly valuable and helpful for comprehending spatiotemporal changes in India's many forms of plant cover and forests. The current taxonomy of forest types will be crucial for studies on carbon stocks, climate-vegetation modeling, vegetation type responses to climatic variability, and biogeochemical cycles, as well as for management of natural resources.

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CHAPTER 8

IMPORTANCE OF AND EFFORTS TO PRESERVE INDIA'S RAMSAR WETLANDS

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ABSTRACT:

The most fundamental and exact aspects of nature, wetlands provide a wide range of purposes including providing drinking water for homes, agricultural use, erosion management, flood control, weather stabilizers, sources of groundwater, water filtration, and detoxification. Despite this, wetlands around the world are experiencing a variety of problems, including a loss in their overall area, an increase in pollutants as a result of industrialization, desertification, and locals' ignorance of the value of wetlands, which is indirectly to blame for the degradation of wetlands. When it comes to the total amount of land designated as wetlands, India comes in first among South Asian nations and third overall in Asia, behind Japan and China. Furthermore, since the first site was recognized as a wetland under the Ramsar Convention in 1981, the number of wetlands of worldwide importance has continuously climbed to 37. India has made great strides in wetlands protection and conservation, from including them under several environmental legislation to developing autonomous wetland regulations and policies that have been updated frequently. In addition to reviewing the significance of the Ramsar sites in India, this article also analyzes numerous wetland legislation and policies and conservation initiatives.

KEYWORDS:

Conservation Initiatives, Erosion Management, Ramsar Sites, Waterfowl Habitat, Wetlands.

INTRODUCTION

An international agreement known as the Convention on Wetlands was signed on February 2nd, 1971 at Ramsar, Iran, which is located on the southern shore of the Caspian Sea. The Convention is officially known as the "Convention on Wetlands (Ramsar, Iran, 1971)," however it is more commonly referred to as the "Ramsar Convention" due to this. The stipulations of Ramsar, the first of the contemporary global environmental accords on the conservation and sustainable use of natural resources, are rather simple when compared to those of more recent agreements. Establishing commitments at both the site- and national-policy levels is unusual.

The Conference of the Contracting Parties has succeeded in keeping the work of the Convention highly relevant to the quickly altering global environment over the years by expanding upon and interpreting the fundamental principles of the treaty language [1].

The Convention on Wetlands of International Importance Particularly as Waterfowl Habitat, the treaty's formal name, emphasizes the original emphasis on the preservation and responsible use of wetlands, particularly as habitat for waterbirds. To include all facets of wetland conservation and sensible use, the Convention has expanded the scope of its implementation throughout time. Wetlands are currently recognized as ecosystems that are essential for the preservation of biodiversity and for sustainable development, thus fully implementing the text of the Convention. Therefore, it is entirely fair to refer to the treaty as the "Convention on

Wetlands" in its increasingly popular short form. (Changing the treaty's name necessitates modifying the treaty itself, a laborious procedure that the Contracting Parties are not currently considering.)

As of January 2016, there were 169 Contracting Parties, or member States, from all corners of the globe. The Convention came into force in 1975 [2]. The List of Wetlands of International Importance (the "Ramsar List") is the "flagship" of the Convention even though the main message of Ramsar is the necessity of sustainable use of all wetlands. More than 2,220 wetlands, totaling 214 million hectares (2.14 million square kilometers), bigger than Mexico's surface area, have currently been designated by the Parties for particular protection as "Ramsar Sites" on this List.

The Ramsar Convention's depositary is the United Nations Educational, Scientific, and Cultural Organization (UNESCO), however it is not an official United Nations body. The Depositary receives, examines, and accepts the instruments of ratification from every signatory nation, maintains the official text of the Convention in its six official languages, and, when needed, offers legal interpretations of the text. The administration and/or implementation of the treaty are not the responsibility of the Depositary.

The Ramsar Agreement

The Ramsar Convention's goal is to conserve and responsibly utilize all wetlands as a means of promoting sustainable development on a global scale. Environmental conventions and agreements under the UNESCO umbrella. The Convention's only accountability is to its Conference of the Contracting Parties (COP), and the responsibility for its day-to-day management has been given to a Secretariat working under the direction of a Standing Committee chosen by the COP. IUCN, the International Union for Conservation of Nature, is the host organization for the Ramsar Secretariat in Gland, Switzerland [3].

The Ramsar Convention's stated purpose is "the conservation and wise use of all wetlands through local, national, and international actions as a contribution to achieving sustainable development throughout the world," as accepted by the Parties in 1999 and clarified in 2002.

Wetlands are what?

Wetlands are places where water dominates the ecosystem and the plant and animal life that goes along with it. They manifest themselves where the land is submerged in water or where the water table is at or close to the surface of the ground. The Ramsar Convention uses a broad definition of wetlands to determine which ones fall under its purview. The definition of wetlands in the Convention's text (Article 1.1) is "areas of marsh, fen, peatland, or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish, or salt, including areas of marine water the depth of which at low tide does not exceed six meters."

Additionally, the Ramsar List of internationally important wetlands' Article 2.1 states that wetlands "may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six meters at low tide lying within the wetlands" in order to protect coherent sites. In general, there are five different types of wetlands: marine (coastal wetlands such as coastal lagoons, rocky shores, seagrass beds, and coral reefs); estuarine (mangrove swamps, tidal marshes, and mudflats); lacustrine (wetlands near lakes); riverine (wetlands near rivers and streams); and palustrine (meaning "marshy" - marshes, swamps, and bogs). Aside from natural wetlands, there are also man-made wetlands, including fish and shrimp ponds, farm ponds, irrigated agricultural area, such as rice paddies, salt pans, dams,

reservoirs, gravel pits, and ponds for wastewater treatment. Located in Uruguay, the Ramsar Laguna de Rocha Ramsar Site is a group of coastal wetlands along the Atlantic coast.

The Ramsar Convention on Wetlands: An Introduction

The Ramsar Classification of Wetland Type, approved by the 5th edition of the Convention, covers 42 varieties and is divided into three groups: marine and coastal wetlands, inland wetlands, and man-made wetlands [4]. The Convention states that marine wetlands are defined as wetlands up to a depth of six meters at low tide (the depth at which sea ducks can dive while feeding); however, the treaty also stipulates that islands and waters with a depth greater than six meters may be included within the boundaries of protected wetlands. It is also important to emphasize that the Ramsar definition of wetlands is interpreted to encompass lakes and rivers in their entirety, regardless of their depth.

Everywhere, from the tropics to the tundra, there are wetlands. It is unknown exactly how much of the earth's surface is made up of wetlands right now. however the UNEP-World Conservation Monitoring Centre has estimated that there are approximately 570 million hectares (5.7 million km^2), or roughly 6% of the Earth's land surface [5]. Around 240,000 km^2 of the world's coastline is covered in mangroves, while there are still an estimated 600,000 km^2 of coral reefs. While stating that "it is not possible to provide an acceptable figure of the areal extent of wetlands at a global scale," a global analysis of wetland resources published for the Ramsar COP7 in 1999 showed a "best" minimum global estimate at between 748 and 778 million hectares. This "minimum" might be extended to a total of between 999 and 4,462 million hectares, according to the same analysis, when other informational sources are considered.

DISCUSSION

One of the most prolific habitats on earth is a wetland. They are sources of biological diversity, supplying the water and basic production needed for the existence of numerous kinds of plants and animals. Birds, mammals, reptiles, amphibians, fish, and invertebrate species can all be found in abundance there. Wetlands are significant genetic resource depots for plants. For instance, rice, a typical wetland plant, is a staple food for more than half of humanity [6]. Freshwater supplies are being overused, endangering both the environment and human health. The degradation of wetlands caused by the quickly expanding gap between water demand and availability compromises human health, agricultural production, economic growth, and geopolitical stability. The ability of wetlands to continue providing benefits to people and wildlife, particularly clean and dependable water sources, is deteriorating, despite present efforts to maintain minimum water flows for ecosystems. It is necessary to improve initiatives to support water allocation to ecosystems, including environmental flow requirements, setting upper limits on water allocations, and new water management legislation.

Wetland ecosystems play many different roles, and their importance to mankind is becoming better appreciated. Large sums of money have been spent to restore the hydrological and biological functions of wetlands that have been lost or damaged as a result. But it's not enough; as world leaders struggle to address the worsening water problem and the consequences of climate change, a race is underway to significantly improve practices on a global scale [7]. And this at a time when the population of the globe is projected to rise by 75 million people year for the next 15 years. As the full effects of climate change on our ecological lifelines become apparent, the capacity of wetlands to adapt to changing conditions will be vital for human populations and species everywhere. It is not surprising that there is a global focus on wetlands and the benefits they provide, especially in light of the Sustainable Development Goals (SDGs)

adopted by the United Nations in September 2015. All of the SDGs, notably those that deal with water, climate, marine resources, and ecosystems, depend critically on wetlands.

Because it can be challenging to put a monetary value on the values and benefits, goods, and services provided by the wetland ecosystem, policy and decision-makers frequently base their decisions on simple calculations of the financial pros and cons of the development proposals before them. As a result, the significance of wetlands for the environment and for human societies has traditionally been underestimated in these calculations [8]. As a result, the discipline of ecosystem service valuation is expanding and employing an increasing number of economists and other experts. There is no other option but to move in this direction given the equivalent monetary values of a healthy wetland and the financial losses associated with a lost or degraded wetland. According to some research, ecosystems provide annual services valued at atleast US$ 33 trillion, of which wetlands are responsible for US$ 4.9 trillion.

Furthermore, wetlands are crucial and even necessary for the safety, welfare, and health of those who live in or close to them. They offer a variety of advantages and are among the most productive settings in the world. Wetlands perform a variety of essential tasks, such as water storage, storm protection and flood mitigation, drought buffering, shoreline stabilization and erosion control, groundwater recharge and discharge, water purification, retention of nutrients, sediments, and pollutants, and more, thanks to the interactions of the physical, biological, and chemical components that make up the "natural infrastructure" of the planet.

Wetlands frequently offer significant economic advantages, including water supply (quantity and quality), fisheries (more than two thirds of the world's fish harvest is linked to the health of wetland areas), agriculture (through the maintenance of water tables and nutrient retention in floodplains), timber and other building materials, energy resources (such as peat and plant matter), wildlife resources, transport, and a wide variety of other wetland products, including herbs). According to Ramsar Fact Sheet 7, "Wetlands: Source of Sustainable Livelihoods," more than a billion livelihoods globally are thought to be entirely or mainly dependent on wetlands Additionally, wetlands have unique qualities as a part of humanity's cultural heritage because they are connected to spiritual and religious values as well as cosmological and religious beliefs. They also serve as a source of aesthetic and artistic inspiration, produce priceless relics from the distant past, protect wildlife, and serve as the foundation for significant regional social, economic, and cultural traditions.

Ecosystems are defined as the complex of living communities, including human communities, and the non-living environment (Ecosystem Components), interacting (through Ecological Processes) as a functional unit that offers a range of benefits to people (Ecosystem Services), in the Millennium Ecosystem Assessment (MA), published in 2006. Provisioning, regulating, and cultural services that directly impact humans are referred to as "Ecosystem Services," as are supporting services required to preserve these other services. Wetlands and water: ecosystem services and human well-being, Finlayson, World Resources Institute, Washington, D.C., has more information. Synthesis Report issued by the MA for the Ramsar Convention. The terminology used in the MA are shown here alongside those used in earlier Ramsar guidelines and papers. In the context of the Ramsar Convention, this refers to the goods, services, and characteristics as described in Resolution

Why do countries sign up for the Ramsar Convention?

Membership in the Ramsar Convention facilitates the development at the national level of policies and actions, including legislation, that assist nations in making the best use of their wetland resources in their pursuit of sustainable development. It also gives a country the chance to speak out in the primary intergovernmental forum on international wetlands issues.

International Cooperation on Wetlands concept, guidelines on management planning in wetlands, access to expert advice on national and site-related issues of wetland conservation and management through contacts with Ramsar Secretariat staff and collaborators, and application of the Ramsar Advisory Mission when necessary

The Convention has repeatedly helped to stop or avoid bad developments that threaten wetlands, according to National Reports submitted by Contracting Parties. Several notable examples include the decision to abandon plans to build a garbage dump at Fujimae, the last significant mudflat system near Nagoya City, Japan, when the city government joined the movement to designate Fujimae as a Ramsar Site in 2001; the decision to abandon plans to build a large new airport that would have included the Cliffe Marshes Ramsar Site, a portion of the Thames Estuary in England, when the UK government determined that "the interconnectedness of The Netherlands Crown Court found in 2007 that the guidelines on buffer zones and Environmental Impact Assessments adopted by the Conference of the Contracting Parties of the Ramsar Convention were invalid. As a result, the Netherlands government canceled plans to build a sizable tourist resort next to a Ramsar Site on the Caribbean Island of Bonaire in the Netherlands Antilles.

Ramsar Site managers in Africa and North America stated in recent surveys by independent environmental legal experts that the designation of Ramsar Sites has helped maintain those wetlands' conservation status, with a common belief that "the designation of a site as a Wetland of International Importance was more than a mere honor; the status offered tangible benefits. These polls frequently cited increased public awareness, higher local stakeholder participation, increased support for site protection, increased access to funds for conservation, and improved chances for research and ecotourism as the advantages of site designation. Additionally, in order to conserve entire watersheds, catchment areas, and deltas and to assure their smart use, a growing number of locations are being designated as Ramsar sites. instances include the Okavango Delta (>5.5 million hectares), the Zambezi River Delta (>3 million ha), and Queen Maud Gulf (>6 million ha), as well as smaller instances of catchments like the Impluvium d'Evian (3,275 ha).

The Ramsar Convention can contribute to the preservation and responsible use of wetlands even if they are not of international significance [9]. To maintain the long-term productivity and efficient environmental functions of all of a state’s wetlands, the legislative and managerial framework required to do so can be established simply by virtue of the State being a Contracting Party to the Convention. The Contracting Parties, the Standing Committee, and the Convention Secretariat work together continuously to implement the Ramsar Convention with the assistance of the International Organization Partners (IOPs), on the advice of the Scientific and Technical Review Panel (STRP), a subsidiary expert body. The Conference of the Contracting Parties, the convention's policy-making body, holds meetings with representatives from the Contracting Parties every three years to discuss resolutions and recommendations that will help the Parties better carry out the Convention's goals.

The Ramsar Convention's Framework for Implementation, which was initially established at the Conference of the Parties in 1984 (Recommendation 2.3), outlined the long-term obligations and the order of importance for the Contracting Parties to give the Convention. Priority objectives for the Parties, the Standing Committee, and the Secretariat for each upcoming triennium have been decided within this framework, which has been amended at subsequent Conference meetings in light of COP decisions. This has been done since 1996 through the use of a Strategic Plan and accompanying Work Plan, which outlined the actions required or expected of the Parties, the Standing Committee, the Secretariat, the STRP, the IOPs, and other partners within the context of the prioritized objectives.

As of right now, the Convention is working under its fourth Strategic Plan, which covers the years 2016 through 2024. The Convention's policy-making body is the Conference of the Contracting Parties (COP). Every three years, government representatives from each Contracting Party gather to hear national reports on the previous triennium, approve the work schedule and financial arrangements for the following three years, and discuss recommendations for the Parties on a variety of ongoing and new environmental issues. Non-member state representatives, members of intergovernmental organizations, and representatives of local, national, and international non-governmental organizations (NGOs) are all welcome to attend these sessions as non-voting observers [10]. Although there is a process outlined in the treaty and the "Rules of Procedure" for voting by the Parties, no substantive decisions have yet been put to a vote; instead, all decisions have ultimately been reached by consensus.

A number of opportunities for presentations and discussions among the Parties about current and future important issues pertaining to wetland conservation and wise use are included in the agenda of each COP meeting, as well as additional interpretation and development of important Convention concepts and guidance for the Parties on crucial implementation areas. In order to enact Resolutions, these matters are discussed in plenary sessions. Ramsar COPs have developed a reputation as being highly effective meetings where key Resolutions are reached by the Parties and where the non-governmental and academic groups are given the opportunity to actively participate [11].

CONCLUSION

Additionally, the Ramsar Convention has an "NGO constituency" in many nations that collaborates with the government and actively promotes and implements the treaty's objectives. In addition to the six partners mentioned above, the Ramsar Secretariat makes every effort to stay in touch with the numerous local, national, and worldwide NGOs whose work aligns with the goals of the Convention and who share Ramsar's guiding values. To be more specific, the Ramsar Secretariat currently enjoys formal cooperative agreements of various kinds with the Albertine Rift Conservation Society (ARCOS), the ASEAN Centre for Biodiversity, Charles Sturt University, Conservation International, Ducks Unlimited, the International Association for Impact Assessment (IAIA), ICLEI- Local Governments for Sustainability, the International Ocean Institute (IOI), the Society for Ecological Restoration, the Society of Environmental Toxicology, and the Society of Environmental Toxicology.

In order to network and influence government policy and action, more and more national and international NGOs are making a point to attend the Ramsar Conference of the Parties meetings; at COP10 in Korea (2008), 25 international NGOs and more than 170 national NGOs were present as observers, and similar numbers were reported for COP11 in 2012. They all offer money for both wetland initiatives and projects that have an impact on wetlands. Additionally, communication is kept open with both the European Commission and the OECD's Development Assistance Committee. Several national development assistance organizations with which the Secretariat also maintains regular contacts frequently give financial help for projects, meetings, reports, and Ramsar-related activity on the ground in the developing world. The Danone Fund for Water and numerous subsequent joint projects, particularly the annual World Wetlands Day activities, have received generous financial support from the private sector Danone Group since 1998 for the Convention's communications, public awareness, and training activities. Participants in meetings of the Ramsar Convention and IUCN have received discounted plane travel since 2007 thanks to the Star Alliance airline alliance's "Biosphere Connections" project.

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CHAPTER 9

PERFORMANCE ANALYSIS OF THE INDIAN FOREST INDUSTRY: AN OVERVIEW

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ABSTRACT:

One-third of the country's geographic area was explicitly stated in independent India's first National Forest Policy, published in 1952, about 70 years ago. However, given the growth in forest cover over the past 35 years, it is clear that this goal won't be reached anytime soon. According to accessible research articles/reports from a secondary literature assessment, the country's forests' quality has dropped over the past 35 years in terms of average productivity, per-person availability, rising stock, and forest type/composition. The paper suggests a multi-pronged approach to achieve the forest and tree cover target and to improve forest quality, emphasizing agroforestry more, adopting an innovative Telangana state afforestation model based on results, creating sustainable green funds by different states, and restoring degraded forest lands by strengthening participatory forest management. In 1952, the newly independent India enacted its first National Forest Policy (NFP). One of the key tenets of the policy was to reach the goal of one third of India's land area being covered by trees and forests. The Policy also established broad objectives for various topographies. Two-thirds of the land must be covered by forest on slopes of hills and mountains where soil erosion risks still exist. The Policy established a modest objective of 20% in plains, where land use pressures are taking dangerous proportions. The National Forest Policy 1988, which followed the National Forest Policy 1952 and has been in effect for thirty years, is still in effect. Climate change, water security, global warming, sustainable forest management, biodiversity conservation, forest rights, and growing urbanization are just a few of the many new issues that we face today.

KEYWORDS:

Forest Management, Forest Report, National Forest Policy, State Afforestation.

INTRODUCTION

The India State of Forest Report (ISFR), which provides an assessment of the country's most recent forest cover (tree cover was added later, 2001 onwards) and monitors changes in the same, was first prepared on a biennial basis starting in 1987 by the Forest Survey of India, an organization under the Ministry of Environment, Forests and Climate change, Government of India. The company serves as a key entity for gathering, organizing, storing, and disseminating the geographical database on India's forest resources. Assessing the state of India's forests between 1987 and the present on a few key metrics, such as productivity, per-person forest availability, growing stock, forest and tree cover, and forest composition using the research papers, studies, and reports that are currently available through secondary literature survey, is an interesting exercise [1].

In 1987, forests produced 0.69 m3 of wood annually per hectare (i.e., on average), which is less than one-third of the global average of 2.1 m3 (ISFR, 1987). the aforesaid value is currently astonishingly low at 0.045 m3 /ha/year. The amount of forest per person has decreased from 0.064 ha in 1987 to 0.058 ha in the late 20s (SFI, 2018).

According to ISFR 1987, India's forests had a growing stock of 65 m3/ha, but by ISFR 2018, that number had dropped to 56.6 m3/ha. As a percentage of the nation's total forest area, tropical moist deciduous woods represented around 37% of the space in 1987, while tropical dry deciduous forests occupied 28.6% (ISFR, 1987). The fraction of tropical wet deciduous forests has decreased to 30.3%, whereas the proportion of tropical dry deciduous forests has increased to 38.2% (ISFR, 2018). Similar to this, tropical thorn forest which consists of thorny shrubs, Prosopis trees, and Acacias has grown from 2.6% in 1987 to 6.7% in 2018 (ISFR, 1987 and ISFR, 2018). All of these facts point to a general degradation in the Indian forest ecosystem caused by a number of factors, with intense biotic pressure in the form of overgrazing, firewood and fodder collection, illegal felling, forest fires, invasion of weeds, climate change, and pressure on forest lands to be diverted for development being among the most significant. The Parliamentary Committee on Science, Technology, Environment, and Forests made damning remarks about illicit tree cutting in its 324th report (SFI, 2018). According to paragraph 6.10 of the report, the government has been spending billions of rupees on environmental protection but our woods have been plagued by the problem of illicit tree cutting and transportation [2].

The committee instructed the environment ministry to take note of this in various regions of the nation and, in collaboration with the relevant state governments and UT 4 administration, establish an action plan for combating the threat. In addition, environmentalists frequently assert that deforestation in the nation is generally underreported. Net growth is only acknowledged when afforestation outpaces deforestation. The forest and tree cover stay constant when natural forests are turned into plantations or orchards, hence such deforestation is not highlighted. This is the highest reading so far for this time period in the nation. The number of forest fires reported over the same months in 2018–19 was around 2,58,480 (Rajya Sabha question response, December 16, 2018), indicating a significant increase. High summer temperatures may be a result of climate change and global warming, but forest fires are also brought on by local villagers' irresponsibility, burning of dry grass, and the convenience of collecting Non-Timber Forest Produce (NTFP).

Regarding ecological stability, the situation is undoubtedly concerning; a third of the world's land area must be covered with trees and forests, but we are still far from the goal. Based on figures for the last 10 years (2011 to 2018, Table 2), it can be seen that the country's forest and tree cover increased by only 3.34% during this time (ISFR, 2011–2018). The aim of 33% forest cover by 2030 becomes improbable even by 2040 at this rate. Critics also contend that India's woods are of doubtful quality. Only 10.88% of the country's geographic area had a forest cover with a canopy density greater than 40% in 1987 (ISFR, 1987), which can be said to be a real forest for emitting forest ecosystem services, such as provisioning (timber, firewood, fodder, genetic resources, clean water, etc.), regulating (carbon storage, climate regulation, pollination, soil erosion prevention, water purification, etc.), and cultural (recreational, aesthetic even now, the situation is the same because only 12.37% of our forest cover has a canopy density of more than 40% (ISFR, 2018). As every hectare of land with a canopy cover of 10% or more qualifies as a forest, forest areas would include plantations growing commercial plantation products like coconut, tea, etc. In contrast to natural forests found in reserved or protected areas, commercial crop plantations may also contribute to the rise in forest cover between 2018 and 2018 (DTE, 2018). This demonstrates how the quantity and quality of natural forests are steadily declining across the nation. India pledged to generate new carbon sinks by increasing the amount of forest and tree cover so that they can absorb 2.5–3.0 billion tonnes of CO_2-equivalent by 2030 (COP 21, Paris, UNFCCC) [3]. India's present forest and tree cover will be increased in order to accomplish this. But it appears that this goal won't be reached given the aforementioned rate of development. This pledge has often been criticized by environmentalists as being overly ambitious, and figures on the amount of forest cover over the last 35 years confirm this claim.

DISCUSSION

Eight states make up India's North Eastern Region (NER), including Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura. With a total area of 2,206,000 square kilometers, this region, known as NER, is a component of the Indo-Burma "hotspot" and is the second largest in the world after the Mediterranean basin. It is known as the Eastern Himalayas physiographically and is home to 51 different types of forests, which can be broadly divided into six categories: tropical moist deciduous forests, tropical semi-evergreen forests, tropical wet evergreen forests, subtropical woods, temperate forests, and alpine forests. Out of the 15,000 kinds of blooming plants in the nation, 8,000 are found in these woodlands. The Indian Red Data Book, a publication of the Botanical Survey of India, states that 10% of the nation's blooming plants are endangered. 800 of the 1500 flower species that are threatened are found in North East India. There are about 220 ethnic communities in the area, and there is a great deal of cultural and linguistic diversity. The North Eastern Region's (NER) forest cover has decreased by 4,257 km2 over the last ten (2011-2018) years, according to the India State of Forest Report 2018 (ISFR) (Table 3). Future ramifications of this reduction are grave given the high biological values, environmental services, and subsistence dependency on NER forests [4].

Moving Onward

The fiscal resources of the Indian government are constrained, and in addition to forestry, many other high-priority areas must also be addressed, including health, education, rural development, agriculture, infrastructure development, defense, communications, and railways. Government programs such as the National Mission for Green India (GIM), the National Afforestation Programme (NAP), the Plantations under Net Present Value (NPV) component of CAMPA (other than compensatory plantations in lieu of forest land diverted for non-forestry purposes), the Green Highway Mission, the Namami Gange Mission, the Nagar Van Yojna, the School Nursery Yojna, etc. have all made significant investments in afforestation (AR, 2018-22). In addition, since the nation's independence, billions of plants have been planted in both forested and non-forested places as part of celebrations for Van Mahotsava. But hitting the 33% target in the end remains elusive. One of the main causes of low forest cover is higher biotic pressure caused by increased people and animal density. Lack of regeneration, overgrazing, fire occurrences, and unsustainable harvesting of fuelwood and fodder are some significant problems with India's forests that contribute to poor forest cover. To lessen strain on not only the country's forests but also its other resources, the government of India and the corresponding state governments must seriously consider developing a human population and unproductive cattle control policy.

The extraction of unsustainable fuel wood from Indian forests has long been a problem, contributing to the degradation of the forests and their inadequate coverage [5]. There are many estimations in this regard, for example, the Forest Survey of India, Dehradun states that it is 216.4 million tonnes annually (ISFR, 2011), whilst another FAO of the United Nations report states that it is between 227 and 298 million tonnes annual. A parliamentary standing committee in 2018 expressed grave worry about this issue and noted that many forest inhabitants and BPL (below poverty line) households living near woods still lacked access to LPG cylinders. According to paragraph 6.26 of the report, the committee advised the environment ministry to exert pressure on the ministry of petroleum and natural gas to work toward enrolling an increasing number of households in the Ujawalla program in order to lessen the strain on the forests (SFI, 2018).

The country urgently needs creative and unconventional ideas/schemes to increase forest and tree cover and achieve India's INDC of additional carbon sink creation by 2030 [6]. Examples include the Telangana state's Haritha Haram model of sustainable greening, promoting agroforestry on farmers' land, and strengthening participatory forest management. According to the ISFR 2018, Telangana state has seen a 6.85% rise in forest cover since 2015 and a 14.52% increase in tree cover since 2015 as a result of the amazing performance of the Haritha Haram scheme (ISFR, 2018).

Approximately 3,36,000 additional acres of forest cover have been added to the state overall. Additionally, Hyderabad's capital city has been named the "Tree City of the World" for the years 2018 and 2018 in a row by the Arbour Day Foundation and Food and Agriculture Organization (FAO) of the United Nations Organization The creation of a special green fund called "Telangana Haritha Nidhi" by the Telangana government is another ground-breaking effort. Since the fund won't be subject to budget restrictions, there won't be any bureaucratic obstacles to its release in time for plantation-related activities. Contributions from members of the Zilla Parishad, Mandal Parishad, municipal corporations, councils, and government personnel are all sources of funding for this fund. Each contractor hired to complete government work is required to contribute 0.1% of the total contract value to the fund [7]. The government adds an extra Rs 50 on every transaction for all registrations, including those for vehicles, real estate, and other things. Additionally, it collects Rs 1,000 for a green fund when business establishment permits are renewed. To help expand overall green infrastructure, other Indian governments can imitate the Telangana state's funding model.

Agroforestry dominates the area of trees outside of forests (TOFs), which are the only method to reach the national target of 33% for forest and tree cover [8]. These states include Haryana and Punjab. According to ICAR-CAFRI (Central Agroforestry Research Institute), there are currently about 26.33 million hectares (ha) of agroforestry in the country, and an additional 25 million hectares (ha) have the potential to be developed in the country to create appropriate agroforestry models in accordance with various climatic zones. Yamuna Nagar, a city in Haryana, is known as the capital city of plywood in India since it is home to numerous plywood and veneer businesses in addition to a paper factory. To supply these mills, farmers grow enough Eucalyptus and Poplar trees in their fields. Additionally, the government of Haryana recently decided to grant licenses to more such mills, thereby encouraging the development of agroforestry in the area surrounding the Yamuna Nagar, Jagadhari, and Kurukshetra districts. Other state governments can follow the Yamuna Nagar approach by encouraging farmers to grow the right agroforestry trees in order to promote such mills. For this type of 8 venture, providing farmers with high-quality planting stock and setting up buy-back agreements with industry are essentiall [9]. The majority of the country's farmlands could become greener if the state governments in charge of such areas paid tree producers the minimum support price (MSP).

Increasing agroforestry will benefit the government, farmers, and the sector as a whole while also contributing to the annual saving of nearly US $ 4.5 billion in priceless foreign reserves. The debate above makes it evident that current national programs have not succeeded in increasing the country's forest and tree cover in the intended manner; as a result, afforestation should be vigorously encouraged through joint forest management (JFM, or peoples' participation) of forests. It is important to promote public participation, especially among individuals whose livelihood depends on trees. JFM experienced an upward trajectory from the 1990s to 2000s, when degraded forests were revitalized and benefits to communities in the form of jobs, income, and non-timber forest products flowed. But following then, JFM went through a period of decline The hand-picking of JFM villages by state forest departments, the

absence of a system for resolving disputes, the lack of engagement from the poor, the ineffective institutional setup, and the lack of confidence between communities and state forest departments are the main causes [10].

FAO vs. FSI: Who is correct - The issue has definitional components. The FAO calculates the rate of deforestation only on natural forests and discusses the figures of plantations separately (these are based6 on government data and obviously do not accurately take into account mortality etc.). The FSI data about tree cover includes plantations on farm and degraded lands (whatever can be observed by the satellite). According to FAO data, India's tree cover rose from 58.30 to 64.96 million ha between 1980 and 1990 when the area under plantations is added to that of wild forests [11].

The widespread prohibition on green felling that several Indian governments have imposed since the late 1980s may be one factor for the better picture. It is not fully known how successful this prohibition has been or how the Supreme Court's order from January 1997 has affected the logging ban. Due to the growth of economic activity off of the land, the relative contribution of forests to state income has been declining sharply since Independence, just as it has for land revenues. As a result, the states are no longer dependent on logging revenue. Additionally, the development of farm forestry, the natural expansion of *Prosopis juliflora* bushes, liberalized wood imports (which totaled 1.3 billion US dollars in 1997–1998 dollars), and other factors have helped to lessen strain on forests [12]. Finally, an improvement in forest cover may have resulted from the success of participatory initiatives. There is scant data on the species composition and changes in the total forest stock, even when the forest cover has not changed.

Demand, Supply, and Costs of Fuelwood

There are a number of predictions for fuelwood consumption, but they are so wildly different from one another that some skepticism is required. Even the estimates of the actual consumption made by various agencies disagree. The Ministry of Environment and Forestry's National Forestry Action Plan, 1999, estimated that only 270 million tonnes of fuelwood were removed from forest lands, whereas NCAER estimated that 94.5 million tonnes of fuelwood were consumed overall in 1978–1979 and TERI estimated that 175 million tonnes were consumed in 1991. There could be a number of causes for these variances. First of all, it is challenging to estimate demand for something that is primarily collected and where substitutions take place. For example, smaller twigs and leaves can replace larger sticks and logs, and where fuelwood is easily accessible and the opportunity cost of labor in rural areas is still low, fuelwood can replace other non-commercial and commercial fuels, which results in higher estimates of needs. Second, it can be challenging to determine the direct and indirect effects of different causal variables, including product price, substitute price, user household size and location, price and income elasticity of demand, and possible changes in the causal variables themselves [13].

Third, fuelwood use is very supply elastic and greatly changes with availability. As an illustration, Hyderabad (Andhra Pradesh), a large city, consumed less than 0.5 tonne of wood per home annually compared to Raipur (Madhya Pradesh), which is surrounded by extensive Household income, the availability and cost of the various fuel sources, the climate, the city's resource endowment, the size of the city, the household's preferred fuel, social traits, eating habits, and regional cooking styles all had an impact on variations in the total amount of cooking fuels consumed by households and the mix of fuels used.

According to the Forest Survey of India (FSI, 1988, p. 46), there was a 130 mt imbalance between the country's domestic production of firewood and demand in 1987. The Planning

Commission's Working Group on Energy Policy has estimated 92 mt, whereas the Advisory Board on Energy has estimated 300-330 mt. Many of these studies' demand forecasts for subsequent years have frequently fallen short of actual consumption statistics in those years, and it has been discovered that the expected demand was inflated relative to actual consumption, frequently by a factor of 2 to 4. This implies that the method used in this research for calculating demand would benefit from being critically examined. First, the term "demand" needs to be clearly defined and separated from "need" or "requirement." Demand measurement is less accurate than consumption measurement [14]. Second, when discussing how to quantify demand, it is important to include the current or predicted price. Prices are not included in the current estimating procedure. Thirdly, the excess of eucalyptus wood in some north Indian markets while there was a scarcity elsewhere demonstrates that the supply-demand imbalance cannot be closed by just increasing production; other constraints may be equally important.

CONCLUSION

The above-mentioned JFM issues must be resolved, with a focus on encouraging agroforestry by involving farmers, creating a sustainable & dedicated green fund, and learning from the Telangana state afforestation model. These actions are necessary for overall management, protection, conservation, and improvement of Indian forests in order to meet the goal of covering one third of the country's area with forest and tree cover and for quality of life. Although there is tragically a lack of empirical data for each of these regions, one could surmise from field research that the last type of region, which may account for almost half of India's land area, has a greater acute fuelwood problem. In forest regions, income inequality rather than physical shortage is the problem, which pushes the underprivileged to engage in head loading. There would also be a class component in regions 2 and 4, where the impoverished and landless would experience shortages while surplus farmers are not affected. Even if they have land, the poor cannot be expected to use it for the production of fuelwood because their immediate concern is finding quick fixes to their dire food and money shortfalls. As a result, the earlier social forestry projects that exclusively focused on fuelwood failed to adequately define what the target community needed.

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CHAPTER 10

PROBLEMS WITH SMALL PROTECTED ZONES IN CITIES: CHALLENGES AND SOLUTIONS

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ABSTRACT:

In order to preserve biodiversity, protected zones have been designated all over the world. Rapid urban growth poses major dangers to protected areas, particularly in emerging nations like India. This research uses the Okhla Bird Sanctuary in Delhi, India, as an example of the current dangers to and effects of urbanization. One of the main causes of the ongoing loss of biodiversity in India and other nations has been recognized as unchecked urbanization and a lack of policy implementation. A potential management plan for a smaller protected area in an urban region is also briefly discussed. The global population is already more than 50% urban and is projected to increase by 1.5% year. Cities throughout the emerging world are expanding quickly and unchecked. As a result, if the current trend of urbanization continues, the line separating protected places (such as National Parks, Wildlife Sanctuaries, Bio reserves, etc.) and cities would continue to blur. According to more than one-third of the world's 825 biologically and geographically defined regions with distinctive biodiversity, known as eco-regions, are urbanized. According to reports, 85% of the world's protected forests have witnessed an area reduction surrounding them, and South-East Asian countries (SEA), which account for a significant amount of the world's biodiversity, are currently witnessing a significant loss of biodiversity. According to reports, South-East Asian nations are losing between 70 and 90 percent of their natural wilderness. India is a tropical nation with a diverse ecosystem. India is the fifth most species-rich country in the world for reptiles, ninth for birds, and seventh for mammals.

KEYWORDS:

Biodiversity, Bio Reserves, Buffer Zone, Protected Zones, Wildlife Sanctuaries.

INTRODUCTION

Known as "a clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values," protected areas are the cornerstones of in situ conservation (IUCN 2008). They are the limited section of the landscape where range-expanding species colonize at a rapid rate. Due to protected areas' crucial contributions to the management of local and global climate, the earth's energy budget, and the preservation of plant and animal species, there has been an increase in concern about protected area conservation worldwide [1]. The designation of the land area outside the protected areas as a "Buffer Zone" (BZ) is one of the ideal strategies to reduce the impact of urbanization and developmental activities on biodiversity inside the protected areas. The buffer zones serve as sturdy barriers that safeguard protected regions from outside encroachment and advancement. The activities within the buffer zones are more of a regulatory than a restrictive character. In terms of controlled resource exploitation, they also meet the needs of the local community. A physical barrier against human encroachment, safety from storm damage, increasing the natural habitat, minimizing edge impacts, and improving the environmental services offered by the reserve are a few advantages of the buffer zones.

Globally protected areas

roughly 100,000 protected areas exist in the world, accounting for roughly 12% of the planet's land area (UNEP 2010). Tropical forests make up the majority of protected areas in the globe. According to Chape et al. (2005), the area under protection increased from 2.4 million km2 in 1962 to nearly 20 million km2 in 2004. In addition, from the 1960s to the 2000s, the number of protected areas listed by the United Nations has multiplied by 10. Over the past 25 years, the global network of protected areas has expanded enormously, especially in developing nations. Many nations have established standards for classifying certain protected zones.

Some nations have figured out how their own classification scheme relates to the IUCN categories (IUCN 2008). Governments in different nations have taken the IUCN classifications and improved them for their own circumstances. Each convention relating to biodiversity offers principles and a framework for activities to be taken at the national, regional, and global levels in order to achieve common objectives of conservation and sustainable use. In order to achieve the goals of biodiversity and protected area conservation, numerous international conventions have created a variety of complementary strategies (site, species, genetic resources, and/or ecosystem) and operational tools (such as work programs, trade permits, access and benefit-sharing, regional agreements, and site listings) [2]. It provides a quick summary of some of the key biodiversity-related international conventions that have recently been held around the globe. The establishment of buffer zones surrounding protected areas is encouraged by a number of international treaties, agreements, and national recommendations for protected areas.

However, it has been determined that the main danger to roughly 180 IBAs is industrial and urban expansion (and the related pollution), together with the building of new roads and other infrastructure It has also been acknowledged that Okhla Bird Sanctuary (OBS) is one of India's protected IBAs. The Indian government has given OBS legal status by designating it as a protected area under the Wildlife (Protection) Act (1972). The OBS is considered one of the prospective "Ramsar Sites" because of its fertile surrounding plains and green belts, which are a part of the Yamuna River ecology. It has several different habitats, such as water features, marshes, grasslands, and a significant amount and variety of trees. All through the year, a wide variety of birds are drawn to these diverse settings. Being the second bird sanctuary to draw over 400 species, after Nairobi in Kenya, which draws over 800 species, this sanctuary is significant on a global scale.

DISCUSSION

One of the main risks to protected areas is acknowledged to be habitat fragmentation and loss brought on by urbanization (NLWRA 2008). The loss, modification, and fragmentation of habitat have a significant negative impact on biodiversity. Greater industrialization and development occur as a result of growing urbanization, creating more prospects for financial benefit. However, this newly transformed urbanized area poses a threat to protected areas, biodiversity, and local populations' efforts to maintain healthy ecosystems Practically speaking, however, things might be different because stopping urban growth does not always result in greater biodiversity preservation or an expansion of protected areas. The implementation of appropriate policies and various other factors, such as proper administration of protected areas, may lead to their sustained growth. Additionally, a variety of causes other than urbanization are to blame for the reduction of protected areas and their biodiversity. Many of these dangers to conservation in protected areas exist outside of them. Threats to protected areas may come from human population growth, poaching, human-wildlife conflicts, slaughter for the meat trade, and the loss of migration routes [3].

Significant research revealed that protected tropical forests are in a far worse condition than previously thought. The study also highlights the fact that numerous plant and animal species are vanishing from forests that are under protection. The most reliable indicators of diminishing protected area health were habitat disruption, hunting, and exploitation of forest products. Furthermore, it appeared that the ecological fate of protected regions was influenced just as much by environmental changes occurring just outside of them. These results imply that protected areas are frequently ecologically closely related to the habitats around them, and failure to detect widespread loss and degradation of such habitats could significantly raise the chance of major biodiversity reductions. Over the past 25 years, the network of protected areas has expanded around the world, especially in developing nations like India, where biodiversity is at its highest. Man-animal conflict will be the most significant problem endangering wildlife in the coming years due to the higher biodiversity and growing human population. To ensure that conservation efforts are prioritized holistically and that all hazards are eliminated in order to ensure the survival of biodiversity in protected areas, mitigation measures must be put in place [4]. Protected areas play a widely acknowledged role as an indicator for global goals and environmental evaluations. Protected areas are regarded as a reliable and quantifiable measure of advancement in biodiversity conservation. Therefore, it is important to realize that measuring the size and quantity of protected areas might reveal governmental commitment to biodiversity preservation.

However, it is also true that biodiversity may not be preserved and enhanced by protected places, many unrestricted forests and lands may actually contain a higher level of biodiversity than officially designated protected areas. The construction of protected areas does not correspond with the established conservation priorities, according to numerous studies. The word "protected area" is a broad one, and each country may have a different definition depending on its conservation laws and objectives. Challenges of tiny protected areas in metropolitan centres, Countries' classifications may differ, which occasionally makes comparisons challenging. Some locations that are considered protected areas in one nation might not necessarily be such in another. Therefore, adopting conservation goals might not actually be a step in the right direction for protecting biodiversity and protected areas. However, research into the biodiversity coverage of these protected areas, species richness and diversity, and habitat classifications can further improve the spatial and geographical characteristics of protected areas [5].

To improve the biodiversity of protected areas and boost their dynamic and conservation productivity, a buffer zone is established. Two of the most frequently mentioned definitions of buffer zones also take into account this disparity in how protected areas are viewed in terms of their functions and goals. Buffer zones are described as "areas peripheral to a national park or equivalent reserve, where restrictions are placed upon resource use or special development measures are undertaken to enhance the conservation values of the area," in one description provided by Buffer zones are described as "areas adjacent to protected areas, on which land use is partially restricted to give an added layer of protection to the protected area itself while providing valued benefits to neighboring rural communities". On the use of buffer zones, there hasn't been agreement, though. As a result, there is ambiguity regarding the goals of buffer zones. There are two contrasting views noted. The first advocated buffer zones as an expansion of national parks, whereas the second promoted buffer zones whose primary function was to integrate people and parks as one of the most effective methods for addressing any current or potential land-people disputes. According to other scholars the protection of the buffer zones should come first, with advantages to the local population playing a secondary role. Benefits in the buffer zone are thought to encourage locals and meet their needs, which will discourage them from taking resources out of these protected regions in the future. However, while

creating buffer zones around these protected areas, a number of factors, including the size of the protected areas, ecological systems, the sensitivity of the local biodiversity, the country's economic structure, legislation, social, and institutional difficulties, must be carefully taken into account.

Case Study: Okhla Bird Sanctuary

Okhla Bird Sanctuary (OBS) is a "man-made wetland" that is thought to be a sanctuary for tens of thousands of migrating birds (28330 0000N, 77170 6000E). OBS is an acknowledged "important bird area" on a global scale. The sanctuary, which is located directly on the Yamuna River between Delhi (at the southern-eastern end) and Uttar Pradesh (near the western boundary of NOIDA, New Okhla Industrial Development Authority), came into being with the construction of the Okhla Barrage in the 1960s. The (Indian) Wildlife (Protection) Act (1972) has previously designated the Uttar Pradesh state side of Okhla as a bird sanctuary. The Yamuna Barrage's Delhi side has not yet been designated a bird sanctuary, nevertheless.

Given that birds are particularly sensitive to changes in habitat layout and composition, the effects of urbanization on birds are very obvious. A multi-scale strategy is necessary for the proper management of bird species richness in urban ecosystems, which is influenced by both local and landscape features. Around 278 different bird species call the OBS home, 89 of which are aquatic and 189 of which are terrestrial. Out of all the species, 75 species migrate during the winter, 8 species during the summer, 3 species between the autumn and spring, and 11 species have been sporadically observed. OBS and the surroundings nearby have confirmed records for a total of 302 species [6]. There are 43 families and about 116 plant species in the area's vegetation. There are 18 species of grass, 4 species of sedge, 53 species of herb species, 15 species of trees, 18 species of shrubs, and 18 species of shrubs. Due to its location in the Yamuna River flood plains, the OBS has a very healthy fish population, which is made up of 87 species of fish from 54 genera and 23 families. Urbanization and other developmental activities Despite being covered by the Wildlife (Protection) Act (1972), the sanctuary has been threatened over the past few years as a result of unchecked human development (such as the building of roads, parks, flyovers, and metro train lines). Despite OBS's status as protected areas and IBAs, the images show unequivocally that infrastructure and industrial growth continue unabated around OBS. The graph depicts changes to the natural area and the industrial area on the Delhi side of the sanctuary in 2010.

On the Uttar Pradesh side, the urban periphery is also expanding. The environmental issues in and around the sanctuary (effluent disposal, pollution, waste, etc.) are being made worse by the expanding industrialization on both sides of the sanctuary. As a result, the area around OBS has seen tremendous change as a result of urbanization. The altered scenery might perplex the migratory birds and alter their behavior and orientation. Additionally, the amount of terrestrial habitat in OBS is negligible to negligible Therefore, OBS would be significantly impacted by the loss of vegetation caused by construction operations in and around OBS for various objectives. The structure and natural functioning of the ecosystem in the sanctuary are also being impacted by the environmental pressure caused by human activities, such as change in land use coupled with increasing air, water, and noise pollution, soil compaction, and solid waste dumping, which needs to be closely monitored in order to implement various countermeasures for effective mitigation.

Additionally, the very survival of OBS is being threatened by the dumping of untreated sewage and industrial effluents into the Delhi part of the river Yamuna, which feeds into it. In fact, the Yamuna River in Delhi is one of the most polluted rivers in India due to the massive amounts of industrial and domestic effluents that are discharged there. With only 2% of the river's length

(*1,376 km) polluted, the capital's 22 km of polluted land between Wazirabad and Okhla barrages accounts for more than 70% of the Yamuna River's overall pollution load (CPCB 1999). According to the CPCB (2011), the water quality in the Okhla barrage is under Class "C," or "moderately polluted class." In 2013, Manral and Khudsar conducted research on the OBS water quality. The study's findings showed that the wetland had significant levels of organic pollution and an algal bloom, with very low DO (2.26 1.62 mg/l), high BOD (15.20 3.75 mg/l), COD (44.60 12.07 mg/l), and high amounts of phosphate (0.64 0.13 mg/l) in the water [7].

The only major city in India with such a big area of greenery is Delhi, which serves as a habitat for several bird species. One of the premier bird paradises for migratory birds is the OBS. As one-third of its territory is in Delhi and the other two-thirds in Uttar Pradesh, the OBS is subject to transboundary urbanization [8]. The bird sanctuary's Uttar Pradesh side, on the other hand, is said to be better kept, while a portion of the Delhi side's bird park is said to be filled with sewage. Because it acts as the last line of defense against land-use activities and hydrological flows, the land surrounding freshwater ecosystems is of utmost significance. Headwater rivers and streams are particularly susceptible to changes in land use. Because the organisms living in these systems rely on terrestrial materials as their main source of energy this copy is the author's own. One of the main factors harming the OBS ecology is the lack of a buffer zone and notified forest area nearby [9].

The Central Empowered Committee (CEC) was recently established at the Supreme Court of India's request to draft the rules for establishing the buffer zone ring around national parks and wildlife sanctuaries in India.

According to the CEC (2012)'s recommendation. the eco-sensitive ring should be kept within a maximum distance of 2 km and a minimum distance of 100 m from the boundaries of the protected parks. It was suggested that due to regional differences in environmental sensitivity and their anticipated interaction with the surroundings, the distance from the boundary of protected areas for the declaration of eco-sensitive zones (or buffer zones) cannot be similarly regulated throughout the nation.

Buffer zones should be established, traffic, construction, and other development activities should be regulated, noise barriers should be installed along the sections, and encroachment, hunting, and grazing should be controlled. In order for the local population to help maintain biodiversity, it is crucial to consult them when creating the conservation strategy.

Numerous management strategies are employed throughout the world to preserve and safeguard biodiversity and maintain vulnerable ecosystems. The formal procedure known as strategic adaptive management (SAM) was created for the preservation and management of ecosystems. It offers a strategy for effective management of complex socioecological systems, such freshwater protected areas and rivers, and is acknowledged as the most logical foundation for continual improvement in natural resource management. (2011) Kingsford et al. It has been successful for South African National Parks (SANParks) to employ SAM to carry out its principal mandate of biodiversity protection SAM, however, has some restrictions in its use in smaller protected areas and is typically only used in larger protected areas. As a result, the execution of a management plan like SAM for a smaller protected area in an urban setting, such as OBS, is likely to differ significantly. In general, India might be used to evaluate the viability and potential of SAM adoption. It depicts a suggested strategy for managing protected lands in emerging nations, particularly India. Priorities, hazards, and severity could all be taken into consideration while determining and setting the objectives. In order to accomplish these goals, numerous strategies and policies are then developed [10].

CONCLUSION

Due to land acquisition from expanding urbanization, the distance between protected areas and cities has been decreasing, and by 2030, a significant fraction of the world's protected regions will be within a day's walk or a half-hour drive of city dwellers. The biodiversity of the protected regions will be severely harmed by this. The OBS, a prime example of an urban wetland in the middle of a crowded city, is under severe threat from growing development, pollution, and a lack of enforcement of conservation standards. This IBA in one of the nation's most densely populated cities has to be protected with the appropriate conservation measures. For effective protected area management, collaborating with regional authorities and local communities, management planning, enhancing institutional and governance capability, and ecotourism are in order of importance (WWF 2004). Many failed policy initiatives in developing nations have been attributed to excessive centralization of environmental protection concerns and poor relationship management with local communities. Decentralizing the management of protected areas is thus acknowledged as one of the potential strategies to reduce the effects of urbanization and associated issues. An essential element for the long term. Public support for natural resource preservation and participation in PAs is essential. For the sustainable management of protected areas, ecotourism and community involvement should be encouraged.

For protected places, many laws and regulations have been passed in India. However, they generally lack implementation, just like OBS did. On the advice of the state government, the Ministry of Environment and Forest, Government of India, recently proposed a draft notice that would create a 100 m to 1.27 km buffer zone around the OBS. The following proposal has been criticized by a number of environmentalists and wildlife experts who believe that a mere 1.27 km (100 m) of width around the sanctuary would not help to safeguard it but will instead put a lot of strain on OBS due to the surrounding extensive urbanization activity. Additionally, it has been proposed that smaller protected areas ought to have wider eco-sensitive zones to lessen the impact of the outside world on their delicate eco-sensitivity.

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CHAPTER 11

LARGE INDIAN RIVER SYSTEMS: A COMPREHENSIVE REVIEW

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ABSTRACT:

Due to the monsoonal climate and tectonic setting, the Indian subcontinent is home to a number of big rivers that are unique in terms of their hydrology and sediment transport features. For the past several decades, many of these rivers have drawn attention from around the world and still do. This essay summarizes important discoveries made during the previous five to six years in the field of huge rivers in India. Glacier-river interactions, erosional history, sediment dynamics, river processes, including flood dangers, alluvial stratigraphic evolution, and river management are a few of the significant topics explored in this essay. A few significant projects on the Ganga River demonstrate to the shift in policymakers' perspectives. Researchers and river managers are both realizing the benefits of using contemporary methods like remote sensing, GIS, digital elevation models, and high-precision measurements like kinematic GPS, Total Station, and ADCP in river surveys. We highlight the emergence of river science as a field of study that aims to investigate the integration of hydrological, geological, chemical, and ecological processes and their interactions, and we recommend that Indian river managers and researchers support this innovative strategy that establishes a link between river management and river health.

KEYWORDS:

Alluvial Stratigraphic Evolution, Erosional History, Monsoonal Climate, River Management, Sediment Dynamics.

INTRODUCTION

One of the most significant continental geomorphic systems that have supported civilizations for more than 5000 years is comprised of large river systems. Large rivers are those that meet one or more of the following criteria: drainage area (A) = 800000 km^2, river length (Lr) = 2500 km, average discharge (Q) = 7500 m^3/s, and suspended and dissolved load (SDL) = 100 mt/yr. There are various ways to approach the topic of huge rivers. The hydrology, sediment transport, and network organization of big rivers are highlighted from a contemporary perspective. This viewpoint also takes into account the process-based knowledge of rivers and river management against the backdrop of future human civilizational sustenance. From a geological or stratigraphic standpoint, it has been noted how ancient massive river systems can be recreated using techniques such as sedimentary basin analysis and long-term alluvial architectural development [1]. The majority of large rivers have large, long-lived deltas which have played a major role in both deep and shallow waters." It is now possible to comprehend how huge rivers developed across a range of time scales, including centuries, millennia, tens of thousands of years, millions, and tens of millions of years, thanks to alluvial stratigraphic records that have been retained in the majority of large rivers and the valleys where they flow.

Study evaluated the geological criteria for the designation of large rivers and analyzed the origin and evolution of large rivers around the world in a variety of tectono-climatic environments. To shed light on their origin and maintenance, maps of the distribution of large current rivers in various geologic settings and climatic regimes were employed. Aspects of the

great rivers' hydrology and sediment dispersion were studied by the authors in light of climatic differences and source area features. The sedimentary architecture that forms beneath the alluvial plains is a direct result of sediment dispersion by big river systems, and unsurprisingly, the large rivers exhibit a strong degree of variety in their alluvial architecture [2]. Numerous big rivers have their beginnings in active mountain ranges and flow into the open ocean after emptying across huge alluvial plains. In various areas of their catchments, these systems are affected by variations in sea level, tectonic activity, and climate, but it is unclear how much influence each of these factors has and how they interact. The major rivers in Asia are depicted in Fig. 1, together with rivers in India that are longer than 1000 km. The Ganga, Brahmaputra, and Godavari are three of the major rivers that flow through the Indian subcontinent.

High sediment output of the Godavari is a consequence of tropical weathering of Deccan Basalts, which results in higher sediment production, as opposed to high sediment yield in active tectonic settings. The future of human populations depends on large river systems, thus it is crucial to understand them in order to protect both their futures and, in turn, our own futures. Large rivers in the south Asian region have supported civilizations for more than 5000 years, creating a population hotspot that is home to nearly a fourth of the world's population. Comparative climatic extremes are thought to have had a significant impact on human settlement, and in certain cases, the detrimental effects of these systems on continental drainages have caused the collapse of significant river bank civilizations. Large rivers and human habitation have a strong interaction that has resulted in major human interventions and consequences on the freshwater systems in the area. Future population growth will probably have an unprecedented influence on freshwater supply in several countries, including India [3]. Because of this, understanding water issues and water security in this region must be based on comprehensive approaches that prioritize dynamic management techniques for natural freshwater systems.

Large River and Cryosphere Interactions

For a considerable portion of India's population, freshwater supply from the Himalayan ice-fields and glaciers is essential since they maintain dry-period low flows for major rivers like the Indus, Ganges, and Brahmaputra Rivers in the south western Himalaya. Due to extensive extractions and human interference, the Indus and Ganges Rivers today have minimal outflow to the sea during the dry season. Realistic quantitative assessments of the hydrological effects of glacier retreat on these rivers' water supplies are still in their infancy. Some data for the Chenab, Parbati, and Basapa basins have been published. According to data on glacial retreat for 1868 glaciers spread across 11 basins in the Indian Himalaya between 1962 and 2001/2004, the total glacial area has shrunk from 6332 km2 to 5329 km^2, representing an average loss of almost 16%. It created a thorough assessment on the Asia Glacier Melt vulnerability with funding from USAID. The two most crucial regulating parameters for glacial retreat,

Large river systems' hydrology will be significantly impacted by glacial retreat, and the data available indicates that the effects may differ from basin to basin. glacial melt contributes significantly (> 50%) to the annual discharge of the Indus and Sutlej Rivers in the western Himalaya, while it decreases (30% in the Tsangpo River) and becomes negligible (20%) in other river basins in the central Himalaya, such as the Karnali River basin., the western catchments are where snowmelt input is most prominent during the pre- and early monsoon season (April to June). The spatial variability is consistent with past research that indicates a 60% contribution from glacial melt in the Sutlej River at Bhakra Dam and a 35% contribution in the Beas River at Pandoh. Based on a hydrological examination of the Ganga River and its principal tributaries, likewise came to the conclusion that the Gangotri glacier's contribution to the Ganga River's glacial melt was minor. Field observations in the Bhagirathi watershed show

that inter-annual runoff fluctuation in lower order rivers is controlled by precipitation rather than changes in the Dokriani glacier's mass balance. Therefore, the Indus River will be more significantly impacted by increased glacial melting than the Ganga River. There may be a growth in an interconnected sub-glacial drainage system, according on limited analysis of the sediment properties of melt water from the Gangotri Glacier.

DISCUSSION

The isotopic composition of the detrital and carbonate fractions from stratigraphic sequences has also been examined in order to establish temporal changes in sediment source areas that alter in response to tectonic/climatic or human-induced controls. A recent study using Sr and Nd isotopes of river sediments highlights a significant difference between the Kosi and the Gandak in terms of current sediment flux and catchment erosion rates. The Gandak's computed flux and erosion rates are significantly higher than the Kosi's (60–130 mt/yr and 1 mm/yr), respectively showed that fluctuations in the sediment provenance as far as the distal Ganga plains were an indication of monsoon-driven changes in the hinterland's hydrological regime. 87Sr/86Sr values and Nd values for a single Fig. 2. The geographic distribution of snowmelt's contribution to the Himalayan Rivers' yearly flow. Rajiv Sinha et al.'s analysis of the interfluve's cores (about 12 km west of the Ganga near Kanpur) revealed substantial intrusions during 70 ka and 20 ka, which coincided with reduced monsoon intensities and maximum glacier cover and hence limited the supply of sediment from the Higher Himalaya [4]. Another study in the same area examined how the 87Sr/86Sr ratio of the Ganga water changed over the previous 100 ka. The 87Sr/86Sr ratio in carbonate nodules from two sediment cores from the Ganga plains at various depths revealed noticeably lower values in comparison to groundwater samples from nearby locations and modern Ganga River water at Kanpur.

An increase in the relative proportion of Sr from the Lesser Himalaya, which contains silicates and carbonates with a higher 87Sr/86Sr ratio, is thought to be responsible for the abrupt spike in the 87Sr/86Sr ratio of the Ganga. Although the reason for the recent rise in Sr input from the Lesser Himalaya is unknown, it is conceivable that recent climate variability, intensive agricultural activity, deforestation, and/or high agricultural activity have contributed to increased erosion of the Lesser Himalayan rocks. The floodplain is the predominant site of silicate weathering for Na, K, and H_2O+, according to more recent research that involved a detailed chemical analysis of suspended sediments in the Ganga River. The scientists have also demonstrated that sediments considerably lose mobile components when traveling through the floodplain using a large data set from source to sink. Weathering in the floodplain was budgeted by comparing sediments sampled at the Himalayan front with sediments from the Ganga mainstream in Bangladesh. This revealed that sediments experience a significant loss in Na, K, Ca, and Mg, which is correlated to an increase in hydration during floodplain transfer.

Based on Nd study of sediments, the Alaknanda basin's erosion history during the previous 7 ka has revealed significant temporal change in the source locations (Wasson et al., 2008). While the Lower Himalaya was the primary source of sediment during the 1970 flood event and the 800–100-year event, the Higher Himalaya made a significant contribution to the sediments deposited during the 400–40 and 2700–700-year events.

Deforestation in the basin area was blamed for the Lesser Himalaya's greater contribution to the 1970 flood event. Further, the nature of sediment transport in the various rivers has been examined along with the grain size variability of the bed load and its regulation [5]. In general, the peninsular rivers are bed load-dominated rivers, and the monsoon season is when the most sediment is transported. The relative weathering of mafic and felsic minerals controls the grain size distribution of bed material in peninsular rivers. According to a geochemical study

conducted in the Cauvery River, the coarse bed load is composed of less weathered felsic minerals, and the geochemical characteristics of sediments depend on the grain size.

According to the Ganga River Basin's grain size distribution, bed load is characterized by an exponential reduction in grain size with distance, and is significantly influenced by lateral sediment intake from tributaries and channel slope. In order to understand the weathering history and extensive sediment recycling in the Ganga alluvial plains adopted a geochemical technique. The nature and characteristics of the sedimentary fill in the alluvial plains are fairly different in response to the prevalent tectonic and climatic circumstances during the orogeny given the diverse litho-tectonic units of the Himalayan source. The Ganga plains' sediments are thought to have come from a source location that was only mildly worn, according to the chemical index of alteration (CIA) and A-CN-K diagrams, and there was no considerable post-depositional chemical weathering. This was linked to increased rates of erosion in the catchment as well as the dynamic Ganga plains' state with its frequent cycles of aggravation and degradation

River Dynamics, Processes, and Flood Hazards

To create a process-based knowledge of India's enormous river systems, two novel techniques have been pursued in recent years. One of them is to use the stream power distribution to comprehend the geomorphic diversity and large-scale landscape evolution [6]. Previous research on the hydrological controls on the geomorphic diversity of the rivers in the Ganga Plains indicated the significance of upstream controls on river processes and geomorphology, and stream power and sediment supply were used as important attributes to characterize those expanded on this work by proposing five major classes for the rivers draining the Ganga based on the type and dynamics of the hinterland in the Ganga foreland basin and taking into account the main forcing factors of the system, such as along-strike rainfall variability, hinterland-basin connectivity, and sea level influence. (3) Northern alluvial plains north of the Ganga and the Yamuna from the mountain front to the Rajmahal-Garo gap; divided into a western part consisting of tributaries with high stream power and incised valleys (3A) and an eastern part consisting of tributaries with low stream power and aggregational valleys. (1) Himalayan hinterland extending from source to mountain exit. (2) Cratonic hinterland comprising the Aravalli lower Ganga Plains and delta south and east of the Rajmahal-Garo gap, and varied degree of incision. Such a dynamic method has not only aided in understanding the relative stages of landscape evolution in various domains of the Ganga Plains, but it has also made it possible to examine the relationships between various components using a systems perspective.

The connectedness idea is another cutting-edge method for comprehending network features and flow characteristics. Numerous landforms or compartments that may be connected in a hierarchical fashion make up a vast river system. However, temporal scale will control the geomorphic connectedness between these landforms. According to an analysis of sediment residence time in the Ganga Plains, source-to-sink connection may occur across timescales ranging from millennia to millions of years (Fig. 4), meaning that the geomorphic landforms in the extensive river system will become detached over shorter time periods.

Contrarily, the records that are currently accessible demonstrate that the Kosi channels were occupied a constrained area in the megafan's east-central region. Within this zone, the channel location did, however, fluctuate erratically. Analysis of the upper 2-3 m of the succession in the megafan's north-central region, meandering stream deposits predominate over sweeping braided river deposits by a wide margin. The authors stress that such a unidirectional shift of the trunk channel in a megafan configuration is practically impossible, both from theoretical considerations and from the findings of numerical simulations. The majority of these

publications reaffirmed the ineffectiveness of technical solutions for large rivers through high embankments and large dams, and they claim that these measures have increased the river's propensity for avulsion by aggravating the bed [7]. Avulsion threshold computation using slope data and flow accumulation analysis using satellite imagery and SRTM-based DEM have been the main topics of additional research on the Kosi. Apart from Kusaha, where the August 2008 breach occurred, numerous other places both upstream and downstream of the barrage are at threshold for avulsion, according to calculations made for the 20-km long length of the Kosi.

Study highlighted the science-policy connection of river migration while documenting the drainage reconstruction of the Ganga River between Rajmahal and Jalangi from 1764 to 2007. The author remarked that the migration of the rivers in this region is not only a significant engineering challenge but also a significant social concern affecting land reallocation, population displacement, and border disputes. Following up on this research, they, made an effort to comprehend the anthropogenic and natural elements that have affected the river's large-scale dynamics during the past 234 years. Reconstructing the Ganga River's morphology from repeated satellite pictures and toposheets reveals that major aggradation issues both upstream and downstream of the barrage began far earlier than the Farakka barrage's commissioning in 1975 [8]. The channel upstream of the Farakka barrage has shifted towards the east since it was built, but the channel changing downstream of the barrage has been unpredictable.

The authors asserted that the river dynamics in this area have been further enhanced by sedimentological readjustments brought on by aggradation and bar growth brought on by the Farakka barrage.

Integration of reach-scale events like river confluence migration with basin-scale processes like sediment flux has been a key component of studies on river dynamics. The confluences of the Ganga-Ramganga and Ganga-Garra have moved both upstream and downstream, according to a recent study by Roy and Sinha (2005, 2007), although no clear trend was found [9]. The next movement of the confluence points during the period of about 100 years is expected to be as large as 20 km. Apart from significant avulsions, the authors hypothesized that river capture, cut-offs, junction angle, and bed aggradation are the main elements influencing confluence dynamics. The analysis of the channel morphology, hydrology, and sediment budgeting between two stations upstream and downstream of the confluence location for the research period was added to this investigation. These analyses demonstrated that higher sediment budgets and the expansion of channel bars occurred at the same times as confluence dynamics.

Hydrological data was also used to analyze the geomorphic effects of fluvial hazards on river channels. In order to analyze the effects of big floods on the Godavari, Tapi, and Narmada rivers; three of the largest rivers on the Indian Peninsula evaluated unit stream power and assessed total energy consumption. According to the investigation, unit stream power values were much greater than the necessary stream power value to entrain pebbles and cobbles, which had a considerable geomorphic impact on the huge rivers. Also statistically analyzed and calculated was the pattern of major floods in South Asia's largest rivers in relation to periods of above-average monsoon rainfall. In general, the majority of the extreme floods have tended to occur between 840 and 2000 AD and have a strong correlation with above-average rainfall at that time [10]. Temporally, from the past (late Holocene) to the present, major floods have become more frequent and larger in size. Compared to late Holocene floods, Peninsular Rivers' current floods have reported larger flood magnitudes. Large floods are now occurring more frequently, and they tend to cluster in the 1940s, 1950s, and 1980s. The "ecosystem based" method, which is implemented at the catchment scale and is cross-disciplinary and holistic, is a probabilistic strategy that acknowledges the complexity and uncertainty of the system. The

physical framework of a river system serves as the fundamental framework for analyzing the compatibility of a biosystem and means of subsistence, making geomorphic characterisation an essential component of a "ecosystem based" approach [11]. This method calls for the integration of hydrogeomorphic and ecological knowledge at comparable temporal and spatial scales, as well as the analysis of data using a shared framework of the hierarchy, connectedness, and nonlinearity features of river systems.

A recent study on portions of the Ganga River integrated hydrological, morphological, ecological, sociological, and hydraulic data for assessment of environment flow (e-flow) at different reaches a geomorphic assessment of habitat suitability. Some efforts have been made in this direction. E-flows are referred to as the flows necessary for maintaining the ecological integrity of rivers, the ecosystems that are linked with them, and the goods and services that they supply (WWF, 2011). Based on the flow stage requirements for geomorphological, ecological, cultural, and livelihood aspects, the e-flow assessment for the Ganga's chosen reaches was conducted. Maintaining longitudinal connectedness and sporadic lateral connectivity by flooding in various reaches was the fundamental geomorphic consideration. Similar to how socio-cultural criteria were predicated on maintaining livelihoods and cultural traditions, biodiversity considerations were stressed to protect the habitat for various species. Hydraulic modeling was used to combine all the data and define the necessary discharge, providing estimates of the flow volumes and depths required for ecological channel management. The study was done for multiple scenarios, such as normal rainfall, a drought year, and heavy rainfall, in order to document temporal variability in the dataset [12].

CONCLUSION

India's extensive river systems require ongoing attention in terms of both research and policy-level actions. We still have a limited knowledge of the mechanisms governing the structure and dynamics of such vast systems. For these vast rivers to be managed sustainably, the causes of the geomorphic diversity and its manifestations must be taken into consideration. Additionally, it is still unknown how climate change may affect river systems in terms of water supply and changes to the hydrological regime. Other serious effects and environmental issues related to glacier melting will occur in addition to the water deficit and, more significantly, the year-round water supply. It has been argued that while the glacier melt would initially result in more water entering the rivers, it would also produce substantial seasonal changes in water availability, increasing the risk of flooding. Rapidly melting glaciers can cause river floods and the creation of glacial melt water lakes, which could represent an even greater threat. Long-term gains from increases in runoff from glacier melt will eventually be countered by these adverse effects on water resource systems.

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CHAPTER 12

INDIAN SUMMER MONSOON RAINFALL AND ITS SPATIAL ANALYSIS

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ABSTRACT:

Changes in rainfall have a big impact on water resources, agricultural productivity, and ultimately the economy. A spatio-temporal investigation of rainfall during the Indian summer monsoon was undertaken to comprehend rainfall variability. Identifying trends in the volume of the Indian summer monsoon at various spatial scales was the goal of the current investigation. Monthly rainfall data at meteorological sub-division level for the period 1901 - 2010 and daily gridded rainfall data (10 X 10 spatial resolution) for the period 1951-2010 corresponding to monsoon season were analyzed. A series of rainfall at agroclimatic areas was created using the gridded data. An investigation based on linear trend analysis was conducted. Methods that were both parametric and non-parametric were employed. It was determined through statistical analysis of the data that there is a tendency toward diminishing summer monsoon rainfall across all of India. Northeast India is one large cluster with a sharp downward trend. Furthermore, there is excellent concordance between gridded rainfall and rainfall based on meteorological subdivisions.

KEYWORDS:

IMD Gridded Data, Meteorological Sub-Division, Agroclimatic Zone, Rainfall, Indian Summer Monsoon, Trend Analysis.

INTRODUCTION

Water is a valuable natural resource, and the majority of it is obtained from rainfall. Reduced rainfall has a negative impact on the economy, agricultural production, and water resources. It is well known that both natural climate variability (such as decadal changes in circulation) and human-induced changes (such as changes in land cover and greenhouse gas emissions) affect rainfall patterns. These elements' contributions and effects vary in time and space and are difficult to quantify (IPCC, 2007). Over the Indian subcontinent, the rainfall has significant socioeconomic ramifications. Therefore, it is important to investigate spatiotemporal variations in rainfall patterns in order to spot regions that are changing quickly.

The Indian subcontinent experiences extreme summer heat that pulls humid breezes from the oceans, followed by the monsoon season. The beginning of the monsoon is referred to as this because it results in a reversal of the winds over the area. In India, the monsoon season normally starts in late May or early June. By the end of June or beginning of July, it has completely engulfed the Indian landmass. The Indian summer monsoon enters a phase of steady decline after the middle of August, when monsoon withdrawal starts. In India, the monsoon season ends in September [1]. Indian summer monsoon (ISM) is a term used by the India Meteorological Department (IMD) to describe a four-month period from June to September, A little period of these four months sees almost 75% of the annual rainfall.

A lot of research has been done on ISM. Long-term rainfall statistics throughout the Indian subcontinent who discovered epochal fluctuations in the ISM rainfall. In their study of the

relationship between ISM rainfall and the El Nino–Southern Oscillation (ENSO), it discovered that ENSO's cool and warm phases corresponded to above- and below-average rainfall, respectively. ISM extremes were linked by Gadgil et al. (2004) to the equatorial Indian Ocean oscillation and ENSO. ISM and sea surface temperature were connected by Sahai et al. ISM's active and break cycles were examined. Despite its regularity, ISM shows significant variability at various time and space scales. The amount of rainfall during the ISM season has been identified by meteorologists as the most crucial component. From a scale as tiny as a single rain gauge site to as large as an entire continent, the spatial scales of rainfall variability span a vast rangethe mean monsoon seasonal rainfall has not altered considerably over the past 100 years. However, concluded that there had been significant changes in the trends of heavy rainfall after conducting investigation over central India. Such divergent findings suggest variation in ISM rainfall in the spatial domain [2]. The time scale ranges from daily to interannual to decadal periods, centuries, and even millennia. Spatiotemporal analysis of ISM rainfall has been taken into consideration in the current work.

In order to determine patterns in the amount of ISM in different regions of India, a spatiotemporal analysis of rainfall around the country was conducted. For the current investigation, two sets of rainfall data were employed, as indicated in Table 1. IMD has prepared the initial set of data, which is a high resolution (10 x 10) daily gridded rainfall dataset. Based on information from 4040 stations, IMD creates a consistent collection of gridded data. Shepard's interpolation approach (Shepard, 1968) is used to generate the grid-point analysis of rainfall over the Indian subcontinent (6.50 N to 37.50 N, 66.50 E to 101.50 E). Shepard's approach is based on weights that take into account directional effects in addition to distances between the station and the grid point. Before beginning the interpolation analysis, standard quality check are carried out. The gridded rainfall data are smoother than the data from individual stations because of averaging. a thorough explanation of how this gridded dataset was created.

The data at 10 × 10 provide fine-scale information. The gridded data may need to be checked for consistency and accuracy at coarser scales. Agro-climatic level (AGCL) information is needed by policy makers. According to the Planning Commission's 1989 classification system, India is classified into 15 agroclimatic areas based on shared characteristics such as soil type, rainfall, temperature, and water availability. Griddled data over India for each ISM era were intersected with a vector layer having these boundaries to determine the value of ISM rainfall at a coarser scale (of MSBD or AGCL). The areas of each grid cell were calculated, and area weighted average ISM rainfall was computed to reflect ISM rainfall for that region because the areas inside 10 × 10 cells are not equal. This was carried out for every 60-year set of data [3]. As in the prior situation, a 30-year moving average and linear trend fitting were used.

For dataset 2, the accumulated monthly rainfall at meteorological subdivision (MSBD) for four ISM months was gathered from www.tropmet.res.in. Both MSBD 1 (Andaman and Nicobar Islands) and MSBD 2 (Arunachal Pradesh) were missing data for the years 1901–15, 1950, 1954–56, and 1971. As a result, the data related to these two MSBDs were not further examined. The monthly rainfall was used to calculate the accumulated ISM rainfall for the other 34 MSBDs. A linear trend was fitted after computing a 30-year moving average.

DISCUSSION

Three different reanalysis products are used in this investigation. These include the NCEP Climate Forecast System Reanalysis the National Centers for Environmental Prediction/ Department of Energy (NCEP/DOE) Reanalysis-2 and the Modern Era Retrospective-Analysis for Research and Applications datasets. Surface latent heat flow (evaporation), surface

precipitation rate, surface pressure, specific humidity, temperature, and the zonal and meridional components of the wind are the variables employed in this reanalysis. Surface pressure, temperature, and specific humidity are used to calculate the potential temperature and precipitable water (PW), respectively.

First, we employ the land surface data as well as the six-hourly global T62 Gaussian-gridded (192 9 81) R2 upper-air data available at 17 pressure levels. Data from 1979 to the present can be found. A two-layer land surface model (LSM) was created by Pan and Mahrt in 1987 at Oregon State University and is used by R2. It makes an estimate of the flow of water between a thin upper layer that reacts to tidal variations in weather and a thicker below layer that reacts to climatic changes. The two soil layers in the OSU plan are 10 and 190 cm thick, respectively.

In addition to the water quantity in the canopy, a comparative study of the Indian summer monsoon expected in these two strata [4]. The surface energy balance can be used to determine the skin's surface temperature. The skin temperature serves as the top boundary condition for the diffusion equation's prediction of soil temperature, while the anomaly averaged climatological deep soil temperature serves as the bottom boundary condition. The Richardson's equation is used to solve the soil hydrology problem, the transpiration is a function of soil layer thickness, vegetation percentage, potential evaporation, canopy resistance, and canopy water content.

Additionally, we employ 17 pressure levels of six-hourly global T382 Gaussian-gridded CFSR upper-air data and the corresponding land surface data. The information is accessible from 1979 until the present. This dataset, which was finished in January 2010, makes use of a connected system of the atmosphere, ocean, land surface, and sea ice. The Noah LSM is employed by the CFSR. Noah has four soil layers (10, 30, 60, and 100 cms thick) as opposed to the OSU scheme used in R2, and the root zone depth varies regionally as a function of vegetation class. The Noah has improved the frozen soil mechanics and snow pack. The ground heat flux, canopy conductance, surface runoff, infiltration, and soil thermal conductivity have all shown improvements. For instance, evaporation is now made to progressively decrease with declining soil moisture instead of abruptly stopping as soil moisture begins to dry out in the OSU system. The ability to replenish soil moisture during wet periods and release it during dry periods has enhanced thanks to the transpiration refinements adopted by adjustments in the canopy conductance in Noah. In comparison to the OSU scheme, Noah LSM is found to generally improve the simulation of surface meteorology Final data sets include one-hourly worldwide (540 9 361) and six-hourly global (540 9 361) Gaussian-gridded MERRA upper-air data (on 42 pressure levels).

The statistics span the years 1979 to 2007 and are a NASA-based product. The Noah-LSM and NASA's Catchment based LSM, which both dynamically estimate land surface water and energy fluxes, are used in the MERRA data assimilation model. To measure soil moisture, it adopts a topographically based strategy as opposed to a layer-based strategy. For each catchment, or computing unit, of the model, the CLSM predicts soil moisture using topography features and bulk moisture factors. Then, as a step up from conventional one-dimension LSMs like the Noah-LSM, it determines the distribution of moisture at a sub-catchment level. However, conclusion that the soil moisture in both the Noah-LSM and the CLSM exhibits a similar response to forcing from the environment and produces values that are equivalent for that field. It should be observed from the table that the three reanalyses employ various data assimilation techniques in addition to various assimilation models [5]. The prevalence of satellite-based observations in recent decades and the ability to directly incorporate radiances in CFSR and MERRA are other significant advancements from R2, even though the conventional observations employed in the three analyses are comparable.

In order to identify the sources of moisture for monsoon rainfall events, our QIBT method makes use of a number of characteristics from the three reanalysis datasets. Latent heat flux, low-level (925-hPa) winds, and precipitable water (PW) are the variables that this study is particularly interested in. The pace at which each of our parcels loses moisture is correlated with latent heat flow (evaporation) and PW, whereas the winds advect our parcels backward and forward in time. We first compute the seasonal (JJAS) means of the variables from each reanalysis.

Throughout this investigation, we compute simple and percentage differences between numerous comparisons. D $ 100% A$B B, where A and B are fields of the same variables but from different reanalyses or different time frames, gives the percentage difference between field A and field B in this study. The degree of the difference between fields A and B in relation to the reference field B is indicated by the percentage difference D. We see that the three datasets' seasonal evaporation fields are qualitatively similar. Each reanalysis reveals high evaporation rates over the water south of India and low evaporation rates across the desert and northern mountain ranges. In each case, the evaporation is higher over southern India than it is over the country's northwest, and it gets smaller as one travels through India from south to north and from east to west.

By calculating each reanalysis's percentage difference from the average analysis, we may additionally observe the uncertainty in the evaporation field. The three reanalyses' averages make up the average analysis. The uncertainties in the wind, PW, and evaporative source between reanalyses will be examined in a similar manner. R2 exhibits notably high evaporation rates over parts of central and eastern Africa, northeastern Pakistan, and northwestern and southern India. According to CFSR, evaporation is much higher over the Arabian Sea and parts of the Bay of Bengal than it is across central and eastern Africa and India (Fig. 1e). In comparison to CFSR, MERRA significantly decreases evaporation in the Indian Ocean while increasing it over central India. The climatological summer evaporation across central India is highest in MERRA, followed by R2, and much lower in CFSR (by as much as 15% less than in MERRA), according to Table 3. Overall, these comparisons imply that the reanalyses' estimates of evaporation during the boreal summer season vary both qualitatively and quantitatively. Most notably, we see that CFSR is most prominent at a seasonal time scale. They are compared for the Indian summer monsoon hydro climate. Of the three reanalyses, R2 is the oldest. As of yet, we have seen that the mean and its variability (of the fluxes and PW) between the reanalyses are considerably more different between the continental than the oceanic components of the Indian monsoon region [6]. We argue that the unequal representation of the Indian Monsoon hydro climate is caused by discrepancies in the LSMs of the reanalyses and the absence of any assimilation of the land surface state variables compared to the atmospheric or oceanic state variables. It is challenging to quantitatively link the variations between the three reanalyses to a particular physical process because the assimilation models of the three studies differ significantly in other areas and they employ various assimilation techniques. Therefore, this study emphasizes the discrepancy between these reanalyses in the hydro climate of the Indian summer monsoon.

One of the incongruent components of the coupled climate system is the interaction between the land and the atmosphere, but with evaporative sources during active and stop periods. The impact of Indian summer monsoon precipitation on soil moisture is evident feedback, but there is debate over how soil moisture can influence precipitation by altering evapotranspiration. The land-atmosphere coupling strength in the moisture constrained regime of the central/north Indian region is, nevertheless, quite strong, as demonstrated by the model intercomparison research.

The soil moisture is positively associated with evaporative flux under a regime where moisture is limited, indicating that variation in soil moisture is the determining factor on the corresponding response of evaporation [7]. To account for the erroneous drying of rain in the monsoonal regions, soil moisture was given to the top soil layer in R2. This resulted in a surplus of moisture for local convection which dessicated the air column above it and caused the observed predominance of the local evaporative source for rain events in central India.

Compared to other models in the Global Land-Atmosphere Coupling Experiment (find that the atmospheric Global Forecast System (GFS; relatively newer version of the atmospheric model from that in)-Noah model exhibits weak land-atmosphere coupling strength.

They do, however, demonstrate that the land-atmosphere coupling strength improves marginally when Noah is coupled to another atmospheric model, while it still remains relatively weaker than other GLACE models. Furthermore, they discover that evapotranspiration in Noah is extremely sensitive to soil moisture in the first 10 cm of soil thickness [8]. In any case, the Indian monsoon's land-based evaporative source has been significantly reduced as a result of the discontinuation of using observed rainfall as in R2 and advancements in the parameterization of the fluxes in Noah demonstrated for MERRA that during the boreal summer it exhibits strong land-atmosphere coupling strength over the Indus valley (which roughly coincides with parts of central India and extends further northwest into Pakistan) and moderate coupling strength over the remaining central India.

R2, then MERRA. In contrast, CFSR reveals significantly higher evaporation rates over the adjacent oceans. The westerly winds in the northern Indian Ocean at 925 hPa are also strongest in R2, but weakest in CFSR. Furthermore, compared to the other reanalyses, the precipitable water in R2 across central India is climatologically less. Due to these characteristics, when comparing uncertainties in the seasonal mean evaporative source computed by a QIBT to average analysis, R2 and CFSR indicate a more local influence of evaporative sources in R2 and a more remote influence of evaporative sources in CFSR. The 925-hPa and PW fields exhibit the most variation between reanalyses when we contrast them on an interannual time frame. R2 (CFSR) demonstrated the biggest interannual fluctuations of local (distant oceanic) sources for evaporative sources. The interannual changes of nearby (continental) and distant (oceanic) evaporative sources were comparable, according to MERRA. According to an analysis of intra-seasonal variations in evaporative sources, the Bay of Bengal and regions to the southeast of India play the most significant roles in supplying moisture for rainfall during active periods. this is most likely related to the occurrence of LPSs and tropical cyclones that are advecting from the ocean and into the continental regions while they are active. In the absence of LPSs, the reverse situation takes place during dry years.

Finally, we find that the intra-seasonal oscillations of the evaporative sources exhibit a different interannual signal across all reanalyses. Our data demonstrates that ISO activity in India is increased in dry years. Furthermore, compared to busy periods, rest periods exhibit greater interannual variability. Given that there is some evidence for seasonal predictability of the interannual variability of the Indian monsoon. This conclusion is significant in that it offers promise for increasing intra-seasonal forecasting. It should be highlighted that the results of this study have implications for enhancing observations during active periods over the Bay of Bengal for better initial analysis for forecasts of tropical storm generation [9].

CONCLUSION

The aforementioned findings show that overall rainfall is decreasing. This need not be examined in isolation, though. Regional land use has changed along with changes in monsoon rainfall. Urbanization has had a major role in the recent changes to land use in India. Significant

changes have occurred as a result of the construction of irrigation systems in the first several five-year plans of independent India. Both the moisture regime and the area used for agriculture have changed. Agriculture is now more intense as a result of this. According to studies, the temperature regimes before and after the agricultural green revolution differed in certain ways. Such a change in land cover has the potential to significantly alter the climate in the future and may have an impact on monsoon circulation. Agricultural irrigation can affect regional evapotranspiration, surface radiative balance, and mesoscale rainfall across the Indian monsoon region. The effects of solar and greenhouse gas forcing would be similar. Though difficult to measure, the effect of changes in land use and cover, such as urbanization and agricultural intensification, on rainfall must be considered.

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