A PEER REVIEWED AND REFEREED JOURNAL

Volume 13, Issue 1, 2022 ISSN: 0976-4534

DOI: 10.53390

INTERNATIONAL JOURNAL ON ENVIRONMENTAL SCIENCES

NAAS Impact Factor 3.06

Published by

NATIONAL ENVIRONMENTAL SCIENCE ACADEMY

206, Raj Tower -I , Alaknanda Comm. Centre, New Delhi - 110 019

Tel.: 9811238475 • E-mail: nesapublications@gmail.com; infonesa88@gmail.com

Website : www.nesa-india.org

Volume 13, Issue 1, 2022 ISSN : 0976-4534

JOURNAL INDEXED IN INDIAN CITATION INDEX

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Editor - in-Chief
Prof. Ashwani Wanganeo
Former: HOD Deptt. of Environmental Sciences & Limnology, B. University, Bhopal.
Director, University Institute of Technology, B. University, Bhopal.
Scientific Member: 24th Indian Scientific Expedition to Antarctica and for establishing and initiating research activity at third Antarctic station
E-mail: profwanganeo@gmail.com • Mobile: +91 94253 01479

International Journal on Environmental Sciences

Volume - 13 | Issue : 1 | *January-June, 2022*

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International Journal on Environmental Sciences

Volume - 13 | Issue : 1 | *January-June 2022*

CONTENTS

National Environmental Science Academy
206 Raj Tower - I
Alaknanda Comm. Centre,
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Incharge Publication
Gian C. Kashyap
nesapublications@gmail.com

Incarge- Accounts
Rakesh Kumar Roy
nesapub@yahoo.co.in

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Members	Rs. 2000.00
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Members	$ 50.00
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Institutional	$ 135.00

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International Journal on Environmental Sciences

International Journal on Environmental Sciences 13(1), January-June 2022, pp. 1-8
ISSN No.: 0976-4534

LIVING ON THE EDGE: VANISHING AND VULNERABLE ISLANDS, SUNDARBANS, WEST BENGAL

Aparupa Datta

Y-East, Sustainability Wing of Techno India Group
Topsia Road, Topsia, Kolkata, West Bengal

Review Article

Received: **14.03.2022** Accepted: **22.03.2022** Published: **05.04.2022**

ABSTRACT

This article is an excerpt from the study (titled the same) undertaken by the author in 2015 on documenting the community's experience of living in the vanishing and vulnerable islands of Sundarbans – the UNESCO World Heritage Site — a site of multiple ongoing ecological processes. The role, experience and knowledge of the human community living within this biodiversity rich region provides an important opportunity to understand not just the human-nature connection, but also the dynamics of co-existence and competition. This article focuses on Mousuni Island which is vulnerable to the impacts of climate change. The resultant dispossession of the people due to coastal inundation by rising sea levels has been the recurring theme in Mousuni island. By building an oral history of land-cover changes, other climate impacts, and how these impacts shaped/are shaping the lives of the residents in Sundarbans, it helped to chronicle the public memory of witnessing the modification of their lived natural habitat, their struggle to cope with this change especially in context of extreme isolation and deprivation.

Keywords: Sundarbans, Climate Change, Oral Histories, Landscape, West Bengal, Ecosystem, Environment.

INTRODUCTION

Communities derive cultural knowledge from the social landscape that they inhabit and function in which leads to assigning of perceptions and values. These values also attach memories to the landscape transforming it into 'sites of historical identity' (Stewart and Strathern, 2003). Over time, perceptions and values may shift "so that the landscape becomes a form of codification of history itself, seen from the viewpoints of personal expression and experience (ibid). These senses of place serve as pegs on which people hang memories, construct meanings from events, and establish ritual and religious arenas of action (ibid)." Memories such as these formed the basis of the study which drew upon the lived experiences of the community residing in the Sundarbans landscape to understand the environmental challenges faced by them and their strategies of coping and adapting with the said adversities.

The Sundarbans Landscape

The Sundarbans covers an area of approximately 10,000 sq. km. out of which, "62% lies within Bangladesh and 38% in India, and forms the largest contiguous mangrove forest on Earth"(Ghosh et al., 2015). During the monsoon season, "tropical cyclones and smaller tidal events regularly hit the area, causing severe flooding and wind damage" (ibid).

This unique deltaic mangrove forest is criss-crossed by a complex network of tidal waterways and carpeted by vast stretches of mud. It is an archipelago of islands that is constantly changing, constantly evolving and yet

*Corresponding author: *aparupa0502@gmail.com*

supporting a delicately balanced ecosystem having a wide variety of fauna notably the Royal Bengal tiger and the estuarine crocodile, over 260 species of birds and the dominant tree species Sundari (*Heritiera littoralis*). A classic example of ongoing ecological processes, the Sundarbans has also been designated as a World Heritage Site by UNESCO.

"The Indian Sundarbans is also home to a large human population of 4.5 million with a population density of 1000 persons per sq. km (Danda, 2010). It is also plagued by developmental constraints like a rapidly growing population, lack of appropriate transportation, modern energy services, basic health care and education (ibid). The primary occupations are paddy cultivation – by raising embankments along the sea ward boundaries to keep salt water at bay and fishing mainly for crabs and prawns (ibid)."

In the fragile landscape ruled by tigers and crocodiles, where the forest plays hide and seek with the tides, the inhabitants of Sundarbans live in harmony braving constant dangers posed by the environment while sustaining their livelihood. Along with frequent attacks from wildlife during forest exploration for sustenance, they face yet another danger – the vanishing islands. The cause is quite well known. Deterioration of the earth's environment is bringing about irreversible changes in the climate; the most pressing problem being the rise in sea levels and submergence of coastal lands. With increasing frequency of cyclones and severe storms, acres of land; land that supported the people with their daily subsistence, land that was home to the mighty flora and fauna, land that would hitherto always re-emerge after a brief period of daily inundation, are being washed away completely never to return. All that remains are memories that aren't an act of nostalgia, but an intelligent interpretation of their lived reality by ordinary people. These can help interpret the present in context of the past and provide important insights into the future.

Memories from Mousuni

Population and Resource Crunch

On the way to the bustling tourist spot of Bakkhali in the serene beaches of Sundarbans, lies Mousuni Island. Hidden from plain sight, one can find this place only if one is actually looking for it. No helpful sign boards mark the turn to this tiny island and neither does it garner so much attention from the tourists thronging the nearby beaches. But it exists; with its population of 30,000 people, a history of lost jungles and a future of rising seas.

Like any other region in the Sundarbans, Mousuni Island too was covered with "dense and tangled vegetation, so thick as to be virtually impenetrable" (Chakrabarti, 2009) or the 'jungle' as the British would call it. A British traveler, Huggins (1824) had said, "I imagine the period is remote when Saugar Island (one of the islands in the Sundarbans) will be metamorphosed into a Brighton, as many years must elapse before the jungle can be cleared away" (cited in Chakrabarti, 2009). Mantaj Ali Shah (2015), an octogenarian who has been living in Baliara mouza in Mousuni since birth gives an early oral history account of the island. He describes how Baliara got its name and the abundance of animals in the tiny island.

"The name of this village – Baliara means huge heaps of sand. It was named so because of the tall mountains of sand that bordered the sea-side boundary of the island. Some were as high as a coconut tree. As kids we would try to climb up these dunes but end up getting tired mid way and lie down on the sandy slope. But, all that has been lost to the sea. Opposite to the sand dune lay the dense forest and then came the sea. The forest had deer, monkey, tigers and many other animals. We did not have so many settlements in this village at that time. Jungle fowls, wild boars and monkeys were also a menace and they would destroy our crop fields. Herds of deer would come and drink water from our ponds in the day time. Tigers would cross over the boundary and steal cattle from the fields just like a cat captures a mouse."

Early attempts at reclamation of land in the 18th century would fail disastrously due to depredations by the 'man-eating' tigers (Chakrabarti, 2009). Lethal control seemed to be the only way to defend the workers from attacks. As a young boy of eight, Shah, M. A. (2015) remembers how a certain man-eater was wrecking havoc in the village and how it was brought under control.

"The tiger had crossed the creek and moved over to Patibuniya village. The Government had assigned a hunter from Sagar Island to capture and kill the tiger. Numerous attempts to capture it failed miserably. A strategy was finally chalked out where people from the other side of Mousuni (in the Patibuniya village) would chase the tiger this way and the hunters positioned here would then shoot it. When it was trying to swim back to Mousuni, it was shot and killed. The carcass was displayed in our market for people to see. Prize money of Rs. 25 was given at that time for killing a tiger."

Permanent human habitation in Sundarbans began in the late 19th century by deforestation "in the low lying tracts through the construction of circuit embankments while the delta was still in a state of immaturity" (Chakraborty, 2005 cited in Ghosh et al., 2015). These tracts were then divided into smaller plots and leased out to "to prospective landlords for timber extraction and the collection of revenues" based on a plan charted out by the British collector general Clod Russell in 1771 (Hunter, 1885 cited

in Ghosh et al., 2015). These zamindars brought in "the poor farming communities from other parts of Bengal as well as from neighboring states to come and settle in the Sundarbans and were put to work clearing the forests and developing the land" (ibid). Hence, the demographic structure of the Sundarbans comprises of "migrant populations from the adjoining districts of Midnapur, and also from central India, predominantly the marginalized and tribal populations who came in search of work and land and who were initially brought in by the British to construct the embankments" (Iqbal, 2011; Danda, 2007 cited in Ghosh et al., 2015). Retired high school teacher, Jalaluddin Shah (2015) of Mousuni recalls how the island was forested when he first came to settle here in 1970s from the nearby Sagar Island. He says,

"Mousuni was surrounded by mangrove forests before and was an extremely fertile island where there was adequate yield of crops especially paddy. The river embankment was hardly taller than 5 feet and never did we face any problems of sea water inundation then. The population of the region was very less and most of them were migrants from other districts of West Bengal like Medinipur. They had settled here during the British rule when Mousuni was still a forested island. Being an island under constant tidal ingress, the British Government had constructed canals after every ten bighas of land to allow excess water to pass during high tides without flooding the area. Gradually, with increase in population, forests were cleared to make way for settlements and cultivation."

Shah, M. A. (2015) adds on a similar account where he says,

"My father had received 15 bighas of land from the British Government when they started settling people here in Sundarbans. The forests were burnt down and settlements were constructed. I remember in 1935, this island was selected for settling people and the first settlement came up in 1942."

Sundarbans was not a densely populated region in the colonial times but it increased rapidly in the post-colonial era, especially after the Indo-Bangladesh partition (Ghosh et al., 2015). After 1947, the population here "grew from 1.15 million in 1951 to 4.44 million in 2011, which led to a growing demand for its resources" (ibid). The same can be reflected in the narrative of Arup Mandal (2015), a resident of Baliara. He says,

"People led a very comfortable life earlier on this island. Everything was available to them; every need was catered to by nature. All resources are still there but the value has increased. In my childhood, I remember settlements were dispersed and scattered. During Kal Baisakhi, it would be a frightening sight to see trees swaying in the thunderstorm; rain and darkness everywhere."

Excerpt from the narrative of Shah, M. A. (2015) serves as a classic example of a correlation that was predicted two centuries ago in the year 1798 by political economist Thomas Robert Malthus. He had warned that unchecked growth of population can lead to severe resource deficiency and it would ultimately lead to a catastrophe.

"It is not that the resources have depleted here. It is the population that has increased.

Settlements have increased with each division of the family. Earlier what was one family has now become five households. Each new household needs firewood which has put considerable pressure on the vegetation here. Earlier rice and straw would be sent to Kolkata. Now, the same quantity of resources is unable to meet the demand here and along with it land area is decreasing. Years ago, we would lend essentials to each other like rice, firewood etc. but nowadays this practice has stopped because we do not have surplus to share."

Land Erosion due to Changing Weather Patterns

A study carried out by WWF – India (2010) says – "There is a clear rise in air temperature over both land and sea. The observed rise is 0.019 degrees Centigrade per year over the Bay of Bengal, and a similar rising trend is also observed in the Sundarbans. The study estimates that if this trend continues, temperature in this area is expected to rise by one degree Centigrade by 2050." Singh's study in 2002 (cited in Ghosh et al., 2015) also shows that there "has been a 26% rise in the frequency of cyclones over Bay of Bengal between the years 1881 and 2001." Shah, J. (2015)'s account supports this argument. He ponders,

"I can feel changes in the weather too. It's hot throughout the year and rains have considerably decreased. Frequency of cyclones has increased. Whenever it is unusually hot in summer, we expect a destructive monsoon. The number of trees has decreased too. Small cyclones would occur every year in the area and with every cyclone the sand embankment would shorten and get washed into the sea. Earlier, the embankments were not so high and inspite of that there would be no flooding. As far as I can tell, it is not only the increased intensity of storms but I feel the island is also sinking. Higher embankments are being needed with passage of time."

Shah, J. (2015) ruminates on how he had to shift his abode twice due to floods and also mentions the possible causes behind the phenomena.

"I also feel that global warming and greenhouse effect are major reasons for weather changes. I have noticed that the seasons have become irregular. It is hot all the time and winters are for namesake only. Rainfall has become variable and storms have become more frequent and

intensified. I have myself built my house three times. I liked to enjoy the river breeze and hence, I had built my home near to the river. Twice it got washed away due to floods. Now I am here."

Shah, M. A. (2015) further elaborates citing quantitative data saying,

"The area of the island was 52,500 bighas when I was working in the Panchayat twenty areas ago. Now, I think it has come down to 30,000 bighas. Kusumtala has faced more erosion than Baliara. The map of the island has changed. There was an outward bend in the Kusumtala area which has now straightened out. Earlier, I remember ships could enter this creek. Now, they can't. The soil that is being eroded from this island is getting deposited in the sea."

WWF-India (2010) have cited various studies that show "the relative mean sea level in Sagar and adjoining areas of the Bay of Bengal was rising at 3.14mm /year; the global estimate of sea level rise was between 0.5 to 3 mm per year. According to this study, such a rise in the Sundarbans area will lead to a 20 cm rise of sea level by 2050 (ibid). The study further mentions that the rate of coastal erosion in the Indian Sundarbans to be about 5.50 sq km/year within the time frame of 2001-2009. A total land area of 6402.09 sq. km of the Indian Sundarbans in the year 2001 was reduced to 6358.05 sq km in 2009 (ibid). This amounts to net land loss of 44.04 sq km which includes erosion of 64.16 sq. km and the accretion of 20.12 sq. km (ibid). Mousuni Island has already lost 14% of its landmass to erosion (ibid) and is the second most vulnerable island to coastal inundation after Ghoramara." Gour Hari Pramanik (2015), an elderly resident of Mousuni gravely predicts a similar future –

"During my childhood days, there used to be a bungalow near the embankment. That area is now in the middle of the river. The area of the island too has reduced a lot. I have heard from many that the depth of the river has decreased leading to inundation. The water level during high tide has increased to 2-3 metres. If a proper embankment is not constructed now, we will have to leave this island very soon. Reforestation was also tried. It was not so successful. Just like there are only 5000 people living in Ghoramara now, Mousuni too will suffer the same fate."

The community's awareness and knowledge regarding the factors causing these troubles is aptly highlighted by an explanation of Shah, J (2015). It goes like this–

"Intensity of floods has no doubt increased here considering the earlier environment of the island. Global warming, siltation of the river etc is leading to rise in water levels, even more than the embankment height. Nowadays, embankments have to be made taller than a height of 15 ft. Then there was Green Revolution. Along with HYV seeds and pesticides, it required a good irrigation network. For this purpose, the outlets of these canals [constructed during the British times to allow tidal waters to pass through] were closed in order to hold rainwater for cultivation in the dry season. It led to flooding as the tidal waters now did not have an outlet to flow.

Another reason for this increased flooding, in my opinion, can be harnessing of hydropower in the middle course of the river leading to rejuvenation. The delta region which earlier fell in the lower course and was characterized by sluggish flow and deposition is now falling in the middle course. There is increased land erosion hence."

Studies have conclusively proved these factors mentioned by Shah, J. (2015) to be one of main causes behind the plight of Mousuni. "In Sundarbans, there is a high turnover rate of aggradation and erosion, which was more or less balanced in the past (Mitra et al., 2009 cited in Ghosh et al., 2015). Today, however, erosion rates are much higher than aggradation, which is most likely the result of artificial sediment traps upstream by dams and barrages in particular areas (e.g. the Farakka Barrage) and higher discharge through water diversion in other parts of the drainage basin (Giri et al., 2007; Mitra et al., 2009 cited in Ghosh et al., 2015). Another concern is the higher amount of melt water from Himalayan glaciers, which increases erosion along the estuaries and thus delivers a higher amount of sediments" (Raha et al., 2012; Mitra et al., 2009; Bannerjee, 2013 cited in Ghosh et al., 2015).

Dispossession

"Over 8000 people were registered missing and about a million were rendered homeless in the two countries when on 25 May 2009, a tropical cyclone (Aila) hit the Sundarbans in India and Bangladesh with a wind speed of 110 km/hr" (Gupta et al., 2009 cited in Ghosh et al., 2015). This cyclone is a recent one in a series of devastating cyclones that had earlier hit the region - 1988, 1991, Sidr in 2007, Nardis in 2008 (Ghosh et al., 2015). Sea level rise owing to global warming, anthropogenic stimuli, and coastal erosion are some other critical issues affecting the region (Raha et al., 2012; Mitra et al., 2009; Bannerjee, 2013 cited in Ghosh et al., 2015), which is eventually destroying mangrove forest and displacing vulnerable, coastal communities. "The cumulative effect of this, described as relative mean sea level (RMSL), has risen between 3.14 mm/year (Hazra et al., 2002 cited in Ghosh et al., 2015) and almost 5 mm/year (Nandy and Bandopadhyay, 2009 cited in Ghosh et al., 2015) in the Sundarbans, which are much higher than global averages, and threaten to inundate close to a billion people" (DasGupta et al., 2014 cited in Ghosh et al., 2015).

The narratives from Mousuni are filled with accounts of dispossession induced by breach of embankments caused by increased storms and resulting in massive floods in the island. Shah, M. A. (2015) mentions,

"After Aila, the situation has worsened and no amount of strengthening of embankments is helping us anymore. There is no place for us to go. There is no place to migrate to. At the onset of monsoons, we become more alert and keep track of the changing water levels in the river. My house was situated close to the embankment but I had to shift back due to flooding in monsoons. Water level reaches waist- deep inside the house. I have still kept the tiles and doors of our previous house. I think I will have to move this year permanently to the interior of the village."

Such type of flooding has become a yearly phenomenon in every monsoon season which is evident when Kayum Khan (2015), further adds,

"Just the sun rises in the east and sets in the west; it is a universal truth in this island that there will be flooding every year. Storm winds blowing from the east in the rainy season indicate disastrous floods. Although relief reaches us whenever we need, nobody is trying to solve the actual problem – the embankment. People are always alert to changes in weather and flooding.

Many NGOs have tried to train people in disaster management and nowadays we receive early warnings of low pressure and bad weather. It started after repeated flooding became a common phenomenon. In case of unusually heavy storms, we leave our mud houses and take shelter in the high schools or any other concrete structure that is available. Mud houses are at the risk of collapsing. This marketplace here becomes fully flooded. The screams and cries of the people during floods can move anybody to tears. It is chaotic and nobody knows where to go and what to do."

Surviving the flood waters is not enough. The deluge brings with itself additional livelihood challenges and biodiversity loss that accumulates over time. Gouranga Mandal (2015) relives his tale of how he had to change his occupation thrice due to flooding.

"We had been cultivating paddy for the past 10-12 years. Our main source of income was from agriculture. I had 5 bighas of land. But after Aila, we have not been able to cultivate for the last 5-6 years due to salt water inundation in the rice fields. In the monsoons during flooding, the waves reach a height of 20 feet and the water gushes in with great force. That cannot be stopped with a simple mud, sack or bamboo embankment. It needs a strong one, may be concrete or block pitching. Mud embankments would invariably give away in times of heavy rainfall. I converted the land into a fishery project. Flooding occurred again and my fishery project also got destroyed.. The fish spawns were carried away by the flood waters and I couldn't recover even my cost of setting up the project. This sweet shop has been there for 30 years. I added a tea stall to it and it is working just fine. We get a daily income to sustain ourselves. I do not have any plans of restarting the fishery."

Shah, M. A. (2015) too has suffered the same fate where he says,

"I own 30 bighas of land but I cannot cultivate it because the soil has become saline. Earlier, no fertilizers were required for cultivation and the productivity of soil was extremely high. I used to work in the fields with my father and I remember it would require quite a lot of effort to thresh them as they were strong stalks of paddy. Now, no amount of HYV seeds is helping to increase the yield."

Loss of livelihood options inevitably leads to migration to urban centres in search of jobs. Mandal, A. (2015) points this out in his account where he says,

"The main impact has been on our primary source of income which is agriculture which has forced people to migrate outside and look for jobs as a construction worker and so on."

Shah, J. (2015) reminisces those days when Mousuni was a fertile land and one could grow a variety of crops. He says,

"We could cultivate watermelons and chilies here in Mousuni. They got destroyed due to untimely hailstorms and excessive rains. After continuous inundation of saline water, these crops cannot be revived here. Paddy cultivation has been affected badly by it. Gourds are the only vegetables that are cultivated here. Even the fish production has decreased here. It is causing the younger generation to migrate to places like Kerala to work as construction labourers. My son too has gone there."

Not only is agriculture affected in this island due to constant tidal ingress, but also fisheries. The community has noticed a gradual decline in the catch both in terms of quality and quantity. However, it seems that they are well aware of the reason behind these changes and admit their own mismanagement as evident from the narrative of Mandal, A. (2015)–

"There were so many varieties of fish in this area; freshwater as well as brackish. Within a few years, it was all gone. Fishing techniques had changed drastically. From small boats, we moved up to motor-run boats and trawlers. The noise from these boats, ripples and waves generated from their movement disturb the fish and they started

changing their habitat. Human greed has no end. With our mechanized boats, we people are chasing the fish and following their trail as far as possible. These boats return after 8-10 days, some successful; some not so successful. These small boats which you see now are actually fishing for small tiny prawns. These prawns are dried in the sun and used as 'fish meal' for poultry. Earlier, these very rivers would yield so much fish. Now, we get almost nothing here."

His account can be supplemented by available literature on the issue. "High levels of pollution, sediment load, and salinity trigger negative effects on the faunal reproduction and growth, as well disturbing composition and distribution patterns" (Shams-Uddin et al., 2013 cited in Ghosh et al., 2015). The population of invasive fish species or "opportunistic trash fish" has also increased significantly, "while the abundance of commercially important taxa has decreased" (ibid). The environment of Sundarbans is irreversibly affected by "such qualitative and quantitative losses in ecosystem services" and may be a trigger for emigration and a resulting "shift in profession" (ibid).

Possible Solutions

In all the narratives collected, there is a common consensus regarding the possible solution to the problem of continuous tidal ingress. It is the construction of stronger, more durable embankments. WWF – India's study (2010) had charted out quantitative data regarding the condition of embankments in Mousuni which is as follows – "the coastal stretch of Baliara is 11.06 km long while the length of the embankment is 8.49 km of which only 1.8 km is brick paved and the remaining 6.69 km is just exposed earthwork. The embankment height ranges from 4 to 6 metres. In August 2008, a 400 metres stretch of embankment along the western border of Baliara was breached affecting 26 hectares of agricultural land. In May 2009, Baliara lost 900 metres of the embankment while its northern neighbour, Kusumtala lost 1200 metres." The Government apathy is evident in the narratives where Shah, J. (2015) comments,

"Political will is severely lacking here when it comes to building stronger embankments. By the time the budget is passed, it is already the rainy season. All that they do is fix up the battered emabankment with mud. It invariably gets washed away due to flooding every year. I remember one MLA giving a speech. He had said that once we politicians get a seat in Delhi, we forget that an island like Mousuni exists. It is true. We receive attention only when something catastrophic happens."

Mandal, A. (2015) is critical in his take on the issue where he says,

"It is strange that the budget for embankments is passed in the monsoon months and the project is given to contractors. If labourers are digging 1000 units of soil, not even 300 units are used in embankments. The rain washes away whatever is dug and the situation remains as it was before. Soil here is sandy in composition. Sand does not have the strength to hold embankments."

Khan (2015) sarcastically slams the politicians saying,

"The politicians drawing out irrigation schemes are probably eating fish that our people catch and sell but they are not bothered about how the people are surviving here."

Although it is the responsibility of the Government to come up with sustainable plans for construction of embankments, the solution does not end there since the problem of erosion and ingress is deep-rooted in India's colonial history. "Indiscriminate construction of circuit embankments to make islands habitable since the British administration, have, over 200 years, altered natural geomorphological processes of delta formation" (Chakraborty, 2005 cited in Ghosh et al., 2015). Increase in the depth of creek beds have resulted into constant inundation of the "low-lying reclaimed areas, turning those areas into vast stretches of permanent marshes that seals off the possibility of these tracts ever naturally maturing into lands habitable by humans" (Bhattacharya, 1998 cited in Ghosh et al., 2015).

CONCLUSION

The study had set out to document the public memories and meaning pertaining to environmental challenges threatening their existence in Sundarbans. It sought to integrate ecological research and social perspectives through the voices of the people who are bearing the brunt of changing climate and limited resources for sustenance and livelihood.

In Mousuni, it reveals the lived realities of the aftermath of land erosion due to climate change and the resultant dispossession of the people. It tries to draw a picture of the island as it was in the past and how it suffered a drastic change in the recent years. It gives us the concept of threatened human security because of climate change. Dispossession induced by sea level rise is causing the local communities to become "climate refugees" (Panda, 2010) which has severe implications not only for the local environment but also in the macro-level socio-economic conditions of the country as a whole. The once self-sufficient community has now been left at the mercy of the rising seas so much so that flooding has become a universal truth in the island.

Based on qualitative research methods, it demonstrates the ability of ordinary people to interpret the ongoing

ecological processes and changes as part of everyday memories and meaning making. These memory based narratives can be the key to unlock coping strategies in the dynamic Sundarbans delta.

ACKNOWLEDGEMENT

The study was undertaken by the author under the guidance of Dr. Shalini Sharma in 2015 in Tata Institute of Social Sciences, Guwahati as a part of her Master's course on Ecology, Environment and Sustainable Development. Dr. Sharma is currently Associate Professor in the Dept. of Humanities and Social Sciences in Institute of Science Education and Research (IISER), Pune.

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International Journal on Environmental Sciences

International Journal on Environmental Sciences 13(1), January-June 2022, pp. 9-12
ISSN No.: 0976-4534

THE ENVIRONMENTAL EFFECTS ON HUMAN HEALTH AND POSSIBLE PREVENTION

Neha Singh, Neetu Bansla, Lalit Kumar Saraswat and Abhay Pandey

Dept. of Computer Science & Engineering
Raj Kumar Goel Institute of Technology, Ghaziabad (U.P.), India

Review Article

Received: **18.03.2022** Accepted: **28.03.2022** Published: **10.04.2022**

ABSTRACT

Environment and health are the two basic need of the human being. The environment is getting worst day by day. Today, we are getting advanced in each and every field but when we come in phase of environment we are not too good. Today, the government is launching the many schemes for the development. The roads and highways are constructed at very high speed but the plantation is zero. That's why the environment is not good in India. Environmental health focuses on the natural things and make environment more comfortable for the humans and makes the health very good of the human being. An ecosystem also known as the environment which is not the single thing only but it is a natural unit consisting of plants, animals and some microorganisms also. Health is totally dependent on the environment. If the environment is good then the health will definitely be good and vice-versa. Environment plays an important role in the development of the human body. In earlier times, the young children use to play with the mud and even eat it also but today due to excessive pollution the mud is also not good so that even small child can't play in it and may skin disease takes place. Today the green vegetables which we eat is not pure many pesticides are used for killing the pest which is creating the bad impact on the human health. Today we are doing many tasks against the environment.We are self-ruining the environment and in back the nature is giving the punishment to usi.e which are destroying our health. We can be fit and healthy by doing the proper and regular exercise but now a day's people are doing the exercise in their houses only because the pollution iss increasing day by day. In this paper, we present the old and modern life style of human being. This paper also presents how the environmental affects the human health and all their possible preventions.

Keywords: Sundarbans, Climate Change, Oral Histories, Landscape, West Bengal, Ecosystem, Environment.

INTRODUCTION

The term "environment" refers to the aggregate of all living and non-living elements, and their consequences on human life (Environmental health, 2021). It maintains biodiversity that provides food, shelter, air, and fulfills all the human needs whether big or small as well as sustainability (Ashok, 2016; Verma, 2019). A clean and green environment with rich biodiversity is needed for ecological balance and survival of entire biota including human beings (Ashok, 2017; Verma, 2018). Moreover, the entire life of human depends upon the environmental factors. "Health can be promoted by encouraging healthful activities, i.e. regular physical exercise and adequate sleep. It also aids in the preservation of many life cycles on the planet.

One of the most important catalysts is the growing awareness of the need for the better environmental management, the environmental challenges that influence human health. In every aspect, the human activities had caused changes in our environment, which have influenced

*Corresponding author: *nehasingh2589@gmail.com*

our health patterns (Human Health and the Environment, 2001).

Economic growth is the only indicator of human progress which is incorrect. We expect urbanization and industrialization to bring happiness and prosperity, but it also brings diseases connected to overcrowding and bad drinking water, leads to increase in water-borne diseases such as infectious diarrhea and air-borne bacterial infections such as tuberculosis (Paul, 2004). Asthma and other respiratory illnesses are more common in high-density metropolitan traffic. Agricultural chemicals are used to boost food supplies during the green revolution that harmed have the farm workers as well as us who eat the vegetables. Antibiotics promised to cure many health problems, particularly those related with infectious diseases, but bacteria have found ways to generate resistant strains and even change their behavior in the process, necessitating the development of new antibiotics.

Many medications have been discovered to have dangerous adverse effects. The remedy can often be as harmful as the disease process itself (WHO, 2002). As a result, development has resulted in a number of long-term health issues. Better health care has resulted in longer life spans and lower infant mortality, but it has also resulted in unprecedented population expansion, which has significant consequences for environmental quality. A greater societal health condition will only result in a better way of life if it is combined with population growth stability.

Fig. 1: Environment and human life.

The World Health Organization (WHO) defines health which means a complete physical, mental, and social well-being, rather than simply the absence of sickness and infirmity (Jaiswal, 2018). Health can be improved by supporting healthy behaviours such as frequent physical activity and getting enough sleep.In underdeveloped countries, 5 children die every minute from malaria or diarrhea. Every hour, 100 additional children die as a result of solid-fuel-related indoor smoke. Every day, almost 3000 persons in low- and middle-income countries die because of road accidents, with pedestrians accounting for the majority of these deaths in the poorest countries. Nearly 19,000 individuals die each month in poor nations as a consequence of unintentional poisoning, frequently as a result of exposure to harmful chemicals and pesticides at work or at home. Every year, millions of people die due to environmental risks and illnesses (WHO, 2002). While the victims share a common fate, their problems are not often linked in today's policy agendas or in decision-makers' ideas and actions.

Public health is concerned with dangers to a community's population's general health. It focuses on infectious illness surveillance control, as well as the promotion of healthy behaviours. Although it has ancient roots, public health is essentially a modern notion in many aspects. It was vital for governments to obtain some understanding of the causes of disease in order to design public health policies and programmers. Polluted water and improper garbage disposal were identified early as factors in the spread of vector-borne diseases. By the time of the Romans, it was clearly established that appropriate waste disposal was a necessary component of public health in urban areas (Melse and Hollander, 2001).

Environmental health, as defined by the World Health Organization, refers to characteristics of human health, i.e quality of life, which was influenced by physical, chemical, biological, social, and psychosocial factors in the environment. It also refers to the idea and practice of analyzing, correcting, managing, and preventing environmental conditions that have a negative impact on current and future generation's health. Our surroundings have wide range of effects on our health. Climate and weather have an impact on human health. Food of acceptable quality, safe drinking water, and enough shelter are all essential for public health. Every year, natural disasters such as storms, hurricanes, and floods kill a large number of people. Unexpected rainfall causes epidemics of malaria and water endured diseases (Fewtrell *et al*., 2003).

FACTORS AFFECTING OUR HEALTH AND ENVIRONMENT

Human activities pollute the water we drink, the air we breathe, and the soil in which we grow plants. All of them have a negative impact on the environment. Despite the fact that the industrial revolution was a huge success in terms of technology, society, and the provision of a wide range of services, it also resulted in the discharge of large amounts of pollutants into the air that are harmful to human health. Without a doubt, global environmental degradation is seen as a multifaceted international public health issue. This issue is linked to social, economic, and legislative

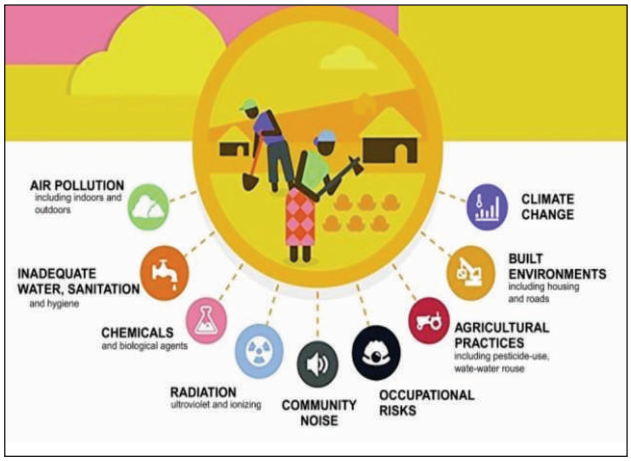

Fig. 2: Factors affecting human life and environment.

concerns, as well as lifestyle behaviors. Urbanization and industrialization previously are at unheard levels and offensives copes worldwide in our time as show in fig. 2.
Today the development is going on everywhere except the rural areas, which creates the imbalance in the society and in the environment as the population is increasing and everyone is moving towards cities. The use of much fossil fuel is creating bad impact on the environment as well as the human health. The use of refrigerator and air conditioner is creating the huge impact on ozone layer due to which it is depleted very rapidly. The glacier are melting due to which the see level rise.

The pollution is increasing very rapidly which make adverse effect on human health and people are getting physically and mentally unfit. The farmers are used to burn the fields which increases the air pollution and factories are releasing the chemical water in the river so which is getting the worse and people living on bank of river are used to drink as underground water (Ioannis *et al*., 2020).

RELATION BETWEEN HEALTH AND ENVIRONMENT

The state of the environment has a direct impact on human health and well-being Clean (Human Health and the Environment, 2001; Jaiswal, 2018) air and water, fertile land for food production, and energy and material inputs for production are all provided by good natural surroundings. Green infrastructure also aids in temperature control and flood prevention. Green and blue landscapes also provides vital recreational possibilities and promote well-being.

At the same time, the environment is a major source of human exposure to pollutants such as air pollution, noise, and dangerous chemicals. The World Health Organization (WHO) believes that environmental stresses are responsible for 12–18% of all fatalities in the 53 nations of the WHO Europe Region in their study on disease prevention through healthy settings. Improving the environment's quality in important areas including air, water, and noise can help to avoid disease and promote human health.

POSSIBLE PREVENTION

Prevention for health

Be active daily and do regular exercise and take a balanced diet. Try to avoid taking unusual things or food which is bad for health. Try to avoid living in that area which is affecting badly our physical and mental health. Time to time regular checkups of the body which is most important for the diagnosis of the body. Always use the mask while going out as the air pollution is affecting our chest and creating breathing problems (WHO, 2020). We should have green vegetables, which are good for our health and mind will be active and fit. We should drink always mineral water and the people who are living on the bank of the river use to drink the underground water get a serious disease.

Prevention for Environment

We should stop using excessive use of air conditioners because the excess amount of heat is released and is creating a bad impact on the environment. We should move towards renewable energy resources so that a large amount of energy can be saved which is affecting the environment (WHO, 2020). We should have more and more trees so that we can get the fresh air and make our earth less warm. We should avoid using LPG cars and bikes we should use the CNG car so that the environment can be protected. Construction should be done in a limited way so that the ecological balance can be made.

CONCLUSION

From all the above views it is clear that if today we will not take creative steps to save the environment, then the conditions will be very worse in next 10-20 years. We have to avoid using the AC as much as we can because we even cannot think also how much it is creating the bad impact on the ozone layer. The plantation is needed each and every place this will create a good impact on the environment. If the industry stop releasing the pollutants in the river then the water will be pure for drinking. If the people avoid using the heavy horn in their vehicles will maintain the noise pollution too. All the mean, is to say that we should avoid doing that task which is not good for health and environment.

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International Journal on Environmental Sciences

International Journal on Environmental Sciences 13(1), January-June 2022, pp. 13-16
ISSN No.: 0976-4534

COMPARE AND CONTRAST CORONAVIRUS VARIANTS AND VACCINATION

Shikha Agarwal[1]*, Neha Singh[2], Neetu Bansla[2] and Lalit Kumar Saraswat[2]

[1]Department of Information Technology
[2]Department of Computer Science & Engineering
Raj Kumar Goel Institute of Technology, Ghaziabad (U.P.), India

Review Article

Received: **22.03.2022** Accepted: **03.04.2022** Published: **16.04.2022**

ABSTRACT

COVID-19 is a type of Coronavirus disease, was declared as a Global pandemic and spread throughout the world. Initially, this disease originated from bats in Wuhan, China in 2019. Ideally, the condition is spread by a mouthful of air or closes interactions with infected globules that has an incubation time between two and fourteen days and extends among the human beings. Today there are millions of infections, viruses and death that have been caused by this disease. In the beginning, the symptoms of this disease include high fever, cold, cough, throat infection, breathing problems and weakness etc. After the first phase, the symptoms are increased as eye infection, headache, vomiting, lungs infection, stomach infection etc and also at the end there are no symptoms but still human beings organs are damaged due to high infection. Around the world, various researchers study the variants of coronavirus and successfully developed vaccines in a couple of years. After developing the vaccine, it was tried and tested on human beings who generate positive and negative impacts. Still, there is no precise treatment for the ailment. This review article not only provides in-depth information on corona virus, its effects but also a comparative information about various mutants of COVID-19 along with possible drugs used worldwide.

Keywords: 2019-nCOV, SARS-CoV, MERS-CoV, Viruses, Vaccines.

INTRODUCTION

A novel CoV appeared a few months ago and wreaked widespread devastation around the world. Several cases of 'viral pneumonia' were recorded in Wuhan, People's Republic of China, in the last two months of 2019 (Wang *et al.,* 2020; Pagliusi *et al.,* 2020). A natural virus of animal origin with the potential for spill over infection was discovered as the source of this infectious disease (Andersen *et al.,* 2020). It is rapidly spreading from its origin to the world. There have been around 96,000 cases reported and more than 3300 deaths till date (Tanu, 2020).

The virus's geographical origins was determined to be Huanan South China Seafood Market, however the animal source of this CoV was unknown. This virus is now assumed to have originated in bats, then moved via one or more intermediate hosts, probably including pangolins, before infecting humans (Meo *et al*., 2020).

Because of its genetic similarities to the CoV responsible for the 2003 outbreak, the International Committee on Taxonomy of Viruses (ICTV) named the new virus as severe acute respiratory syndrome coronavirus 2 (SARS-CoV2) on February 11, 2020. It belongs to a large group of enveloped, single-stranded, positive-sense RNA virus which has capability of affecting animals, human beings,

*Corresponding author: *neetufcs@rkgit.edu.in*

birds, rodents and other mammals. Later, the virus was spread rapidly due to which WHO (world health organisation) dubbed the disease "COVID-19" and declared it a global pandemic on March 11, 2020, based on guiding principles previously agreed with the World Organization for Animal Health (OIE) and the United Nations Food and Agriculture Organization (FAO).

The Covid-19 disease is transmitted by contact with an infected person or inhalation (Kumari and Shukla, 2020). Its incubation period is between 2 to 14 days. When the patients were diagnosed, it was observed that few patients were asymptomatic and some had mild symptoms like respiratory discomfort, fever, cold, cough etc. It exerted both positive and negative impacts on environment and society including biodiversity and economy (Verma and Prakash, 2020; Roy and Chaube, 2021). A systemic approach and social medicine have been proved very useful during Covid-19 pandemic (Roy *et al.*, 2020; Balwan *et al.*, 2021).

1. TYPES OF VIRUSES

Coronaviruses are members of the Coronavirinae subfamily of the Coronaviridae family. The severity of the disease caused by different varieties of human coronaviruses varies, as does the extent to which they can spread. There are now six varieties of coronavirus that can infect people, according to doctors.

1. 229E (Alpha coronavirus) - It is one of the first human coronavirus strains being described. Its common symptoms are cold and cough in healthy adults. Young generation and old aged people considered weak to develop lower respiratory infections.

2. NL63 (Alpha coronavirus) - Initially it was found in young children having severe lower respiratory problems admitted to hospital. The comorbidity of this virus with respiratory infections. A study of NL63 patients symptoms are croup, bronchitis and pneumonia etc.

3. OC43 (Beta coronavirus) It is a member of Beta coronavirus1 family, which affects human and cattle's. The common symptoms are fever, dry cough and tiredness. But less common symptoms are aches and pain, sore throat, loss of taste and smell and headache etc.

4. HKU1 (Beta coronavirus) The common symptoms are rhinorrhea (100%), cough (67%), fever (67%) and abnormal breath sounds on auscultation (44%).

The below two variants are majorly communicable, contagious and stern in its hit throng the second wave.

5. K417N (Delta Corona virus) This variant is considered tremendous due to severity of symptoms, it causes. It includes high lung involvement, severe respiratory infections and gastrointestinal problems even in mild or moderate cases.

6.L452R and P871R (Delta+ Corona virus)-This variant is more severe in nature which carries more features than Delta variant and Beta variant. The symptoms are similar to delta variant but still required some concerns and more attentions. The symptoms are early- stage lung involvement, appetite loss and nausea, dryness and watery eyes, longer lasting fever and persistent cough etc.

SYMPTOMS

Cold, Cough and Fever like mild symptoms usually set in 2-4 days and it may vary from person to person. But some forms of virus can be fatal. The Common symptom includes:

- Asthma problem
- Sore throat
- Fever
- Sneezing
- Running Nose
- Cough
- Diarrhoea, etc.

Researchers cannot easily nurture human coronavirus in their laboratory. This makes it difficult to measure the impact of coronavirus on the world economy and human health. There is no specific treatment, only self-care and over the offset it requires medication. Public can take several steps as:

- Drink plenty of water
- Avoid drinking alcohol and smoking
- Using a cool mist vaporizer
- Avoid overexertion, take more rest
- For common colds and fever take doctor's consultation
- Testing for the virus can be done by taking the sample of respiratory droplets, such as mucus from the nose and blood.

Regularly washing hands, wearing masks, etc. are recommended. Avoid close contact with anyone who shows symptoms of coughing and sneezing.

CATEGORIES OF VACCINE

There are several types of vaccines. Each category is designed for your immune system, how to fight against different kinds of germs and bacteria. When the scientist creates vaccines, their research based on various parameters as:

The comparative study on various types of vaccines on the basis of different criteria are listed below in Table 1.

Table 1: A comparison of various types of vaccines.

Criteria/ Vaccines	Pfizer	Moderna	Janssen	Astrazeneca	Novavax	Sputnik-V
No of doses	2,21 days apart	2,28 days apart	1	2,4-12 weeks apart	2,21days apart	2,21 days apart
No of doses	2,21 days apart	18+ years above				
No of doses	100%					
No of doses	YES					
Type of vaccine	mRNA	Viral vector	Recombinant protein/adjuvant	adenovirus viral vector		
Side Effects	Fatigue, headache, chills, muscle pain					
Test on children	Yes, ages 12-15	Yes, ages 12-17	Testing under process, declared soon			
Who can't vaccinate?	Allergic reactions to first dose	Allergic reactions	Declared soon			Allergic reactions
Effectiveness against in US clinical trials	Overall 95%, 86% in 65+ age	Overall 94.1%, 86% in 65+ age	Overall 72%, 86% against severe disease	Overall 70%, 100% for severe 0disease	95.6% (UK trials)	91.6%

a) How the immune system responds if they take vaccine.

b) Who needs to get vaccinated against germs

c) What is the best approach to create vaccine?

Based on the above factors they have created various categories of vaccine as follows:

4.1. Inactivated Vaccine: It is called as killed vaccines. It uses the specific bacteria (pathogens) or virus particles, which have been killed through chemical processes and heat. The dead pathogen introduced in the human body. It also helps the body immune system how to fight with the new versions of the pathogens e.g. polio.

4.2. Live, Attenuated Vaccine: It is Live vaccine where the pathogen is remains active, is modified in such a way that the pathogen is not able to cause disease itself but can produce full-bodied immune response. Live, attenuated vaccines do not cause serious disease in people with healthy immune systems. These vaccines lead to a stronger and healthy immune system e.g. Chickenpox, measles, mumps and rubella vaccines.

4.3. DNA/RNA or Genetic Vaccine: A small part of the pathogen's genetic information to cause an immune response without causing disease or harm. In this vaccine, one booster dose is needed to get protection against disease e.g. HIV, Hepatitis B, whooping cough.

4.4.Vector Vaccine: It works by giving instructions to genetic cells to produce antigens**.** It takes a “harmless” non-infecting virus, or made one in the lab, and “infuses” it with a potential target protein to create a “vector” virus. Injecting this vector virus into the human body tricks the immune system into thinking that it is facing a real infection and causes an immune response to be generated and stored for future reference.

5. COVID-19 VACCINES

There are a number of drugs that have been proposed for the treatment of Covid-19. Along with traditional therapeutics, monoclonal antibodies, convalescent blood plasma,

peptide-based and oligonucleotide medicines and interferon therapies(inhaled interferon beta) have been used for treatment. As more than 80% of the Covid-19 patients suffer mild symptoms, so they need not a special medical treatment and drugs. The best way for them is to isolate themselves from others along with a healthy diet. Mostly, old- aged people and patients with severe conditions are required to be admitted to the hospitals because sometimes they may need special attention i.e oxygen and ventilator. So, there are different types of Covid-19 vaccines available all over the world.

- **Pfizer:** Pfizer Inc. is an American multinational pharmaceutical and biotechnology corporation headquartered on 42nd Street in Manhattan, New York City. This vaccine is reported to be approximately 95% effective at preventing COVID-19.
- **Moderna:** Moderna is an American pharmaceutical and biotechnology company based in Cambridge, Massachusetts. Early results indicate it is safe and produces high levels of antibodies to the SARS-CoV-2 virus. This vaccine is also reported to be approximately 95% effective.
- **Johnson & Johnson (Janssen):** Johnson & Johnson COVID-19 Vaccine Authorized by U.S. FDA For Emergency Use - First Single-Shot Vaccine in Fight Against Global Pandemic
- **Astra Zeneca:** Astra Zeneca has partnered with **Serum Institute of India (SII)**, the world's largest vaccine manufacturer, for the supply of the vaccine to the Indian Government but also to a large number of low and middle-income countries.
- **Novavax:** Novavax, Inc., is an American biotechnology company based in Gaithersburg. Serum Institute of India has started the production of the first batch of Novavax (known as Covovax in India) covid vaccine.
- **Sputnik V:** Moscow Mayor Sergei Sobyanin announced that the newly opened Moscow-based "R-Pharm" will become a leading manufacturer of Russia's Sputnik V coronavirus vaccine.

CONCLUSION

Different vaccine techniques are expected to be used in the future to combat new variations as they emerge. Changing the vaccine dose, adding booster doses, combining vaccines, or altering the vaccines themselves to target variations are all possibilities.

To obtain the best protection, scientists are already developing "next generation" vaccinations and techniques. Researchers are working hard to foresee changes and plan for future issues as our understanding about the COVID-19 virus enhances; including how it spreads, how it mutates, and the impact of variants.

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International Journal on Environmental Sciences

International Journal on Environmental Sciences 13(1), January-June 2022, pp. 17-21
ISSN No.: 0976-4534

CONSTRUCTED WETLANDS FOR MUNICIPAL WASTEWATER TREATMENT: A SUSTAINABLE APPROACH

Monali Muduli[1,2] and Sanak Ray[1,2]*

[1]Analytical and Environmental Science Division & Centralized Instrument Facility
CSIR-Central Salt & Marine Chemicals Research Institute, G.B. Marg, Bhavnagar, India
[2]Academy of Scientific and Innovative Research (AcSIR), Ghaziabad, India

Review Article

Received: **05.04.2022** Accepted: **15.04.2022** Published: **28.04.2022**

ABSTRACT

Water, the most valuable gift of nature is at a critical stage so called pollution, due to intense industrialization, urbanization and exponential population growth. Thus, a diagnosis that has the potential to cure that critical stage of water with no harmful impact on the other elements of nature is an utmost requirement now a days. Tremendous development in the field of research has suggested a number of treatment methods to get over water pollution. Constructed wetland (CW) an engineered unit that follows bio-geochemical approaches to heal the polluted stage of water with a significant pollutant removal efficiency, has stood first in the field of sustainable water treatment and technology. Not only water treatment through an eco-friendly manner but also creating an ecosystem within that working area with aesthetic and economical production are the major reasons behind the popularity of this system. Selection of vegetation, substrate and construction of that system at a proper location are the limitation of constructed wetland. In this system sedimentation, filtration and adsorption through substrate, neutralization, and precipitation, phyto-accumulation of plant species and microbial remediation by microorganisms present in the rhizospheres of plants etc. are the processes that supports the treatment activity. This paper discusses various types of constructed wetlands and their mechanism and performance intended for municipal wastewater treatment. Besides it the paper covers the discussion regarding reusability of the treated water. This paper will help promote the wastewater treatment using CWs and further help to design and develop innovative hybrid technologies for sustainable wastewater treatment.

Keywords: Constructed wetland; Municipal wastewater; Wastewater treatment; Removal efficiency; Reusability.

INTRODUCTION

Water pollution is one of major difficulties that the entire world is facing recently after global warming and climate change (Verma, 2021). It has been reported, keeping view on the huge population growth with changing lifestyle and rapid urbanization and industrialization that the volume of wastewater will increase by 30 % by 2030 and 51% by 2050 from the existing volume. So, it is a carry-on call to us to be attentive and prepared for the wastewater treatment and reuse of that water for various purposes otherwise it will cause a severe water crisis in future (Qadir et al., 2020).

Municipal wastewater is one of the major contributors to this big issue that has made whole world alert about water security, conservation, wastewater treatment for reuse purposes. Basically, municipal wastewater is nothing but a blend of residential and commercial zone run off with minor contribution of infiltration from the subsoil (Gilmour & Zimmerman, 2020). Major components of municipal wastewater are suspended and dissolved inorganic and organic solids like carbohydrates, lignin, fat and protein, synthetic soap and detergent, heavy metals, e-wastes, phyto hormones, antibiotics etc. (Pereira et al., 2014; Verma and Prakash, 2020). Thus, we may assume

*Corresponding author: *sanakray@csmcri.res.in*

that treatment of municipal waste water has the capacity to provide water, energy and nutrient after operation and treatment (Qadir et al., 2020). Proper treatment and utilization may lead to sustainability, which is the need of today (Verma, 2019).

The most important thing is to identify an excellent, pocket friendly and green technology with high pollutant removal efficiency and productivity. Although there are various methods like chemical, biological and physical methods, but no method is approachable solely for the treatment. Constructed wetland (CW), an engineered advanced ecological system that practices bio-geochemical processes, to treat wastewater with no harmful impact on environment. The mechanisms that occurred during the operations are sedimentations and filtration (coming under physical processes), precipitation and adsorption (coming under chemical processes) and microbial remediation, phyto remediation, phyto adsorption and natural die off (coming under biological processes) (CPCB, 2019). Advantages like using less space for the construction of CW, simple operation and maintenance, low capital cost, no chemical use, less sludge production, a little electricity consumption, sustainability, high pollutant removal potential etc. are playing the key roles for making this system suitable for municipal wastewater management (Ali et al., 2018; Corbella & Puigagut, 2018).

The performance of the system depends upon various factor like geographical location of the system, meteorological parameter, substrate, hydraulic gradient, residence time of effluent, flow rate of effluent, water depth, feeding mode, plant species, microbial growth etc. The engineered system has the potentiality to treat the pollutant like TSS, TDS, total nitrogen, total phosphorous, BOD, COD, heavy metals, microbial community and emerging contaminants etc. (Abou-Elela et al., 2017; Ji et al., 2022; Shukla et al., 2021).

Constructed wetlands can be categorized in various forms on the basis of types of hydrology, vegetation and flow of the water. On the basis of hydrology and flow type they are classified as subsurface flow and free surface flow CW and subsurface flow CW again classified as horizontal and vertical flow CW respectively. Vegetation's (potential to survive in worse climatic situations, having fighting nature for waterlogged-anoxic as well as hyper-eutrophic situations) play the most important role for removal of pollutants in the CW (Rahman et al., 2020). Thus, on the basis of vegetation CWs are also categorized into submerged, floating leaved, free floating and emergent macrophytes types (Vymazal, 2010)

Constructed wetland for Municipal wastewater

Various designs like horizontal sub-surface flow CW, Vertical sub-surface flow CW, Hybrid CW, Multi stage CW etc. and some modification and addition of advanced technologies are there to treat and recover energy, nutrient etc. from municipal wastewater and make fit that treated water quality for reuse purposes.Overview of various constructed wetlands treating municipal wastewater were shown in Table 1.

A Comparative study was performed by (Masi et al., 2013) to evaluate the performance of multistage constructed wetland. Thus, they designed a four stage CW at Dicomono in Italy and a three stage CW at Chorfech in Tunisia. By evaluating the performance, they concluded that multistage that means four stage CW was capable to treat the municipal wastewater significantly with removal efficiency 86%, 60%, 43%, 89%, 89%, 76% for the Organic Load, Total Nitrogen (TN), Total Phosphorus (TP), Total Suspended Solids (TSS) and Ammonium (NH_4) respectively and reduction in the pathogen concentration was achieved up-to 4 -5 logs.

Table 1: Overview of various constructed wetlands treating municipal wastewater.

Wetland type	Scale	Substrates type	Plants type	Flow Rate mode	Feeding removal (%)	Pollutant	Source
Hybrid CW (VSSFW + Phyto-treatment Pond)	Full Scale	coarse sand (1.25–2.0 mm), medium gravel (6–15 mm), coarse gravel (35– 60 mm), cobbles (65–98 mm), and broken brick pieces (101–152 mm)	*Phragmites australis, Canna indica, Typha latifolia*		Continues	COD = 56.03; BOD = 57.02	(Z Ali *et al*., 2018)
Sub Surface Flow Kickuth Type CW	Full Scale	Humus straw local soil (Loamy Soil)	*Phragmites australis*	116 m^3/d		BOD5 = 91.60; COD = 89.82; TSS = 95.62; TN = 17.44; TP = 23.07	(Mucha *et al*., 2018)
Hybrid CW (HSSF-CW + FTW)	Full Scale	River washed Gravel (8mm)	*Phragmites australis, Iris pseudacorus*	200 m^3/d		TN =74.3; NH_4-N =62.1; NO_3-N = 77.7; TP =29.6; PO_4-P = 37.4; COD= 46.7	(Barco & Borin, 2017)

MFC-CW	Lab Scale	gravels (5–12 mm), sands (0.5–2 mm)	*Water Hyacinth*			TN = 88.78 ± 3.98	(Tao et al., 2020)
Multistage CW	Full Scale	Silex granite river gravel	*Phragmites, Typha*	$5m^3/d$	Batch	>95 for (SS, BOD_5 and $N\text{-}NH_4^+$) >90 for (COD and $PO4\text{-}_P$) > 5 log units of coliform and 100 helminth egg	(Torrens et al., 2020))
VSSF-CW	Pilot Scale	Sand gravel	*Cyperus papyrus*	$0.6\ m^3/d$		TP= 50a mmoniacal nitrogen = (69.69), BOD = (69.87), COD = 80.69, total coliforms = 98.08 fecal coliforms = 95.61	(García-Ávila, 2020)
VSSF-CW	Pilot scale	Gravel pozzolan sand	*Phragmites australis*	60 L/m2 /d	Batch	COD = 91; polyphenols = 89, PO_4^{3-} = 94; SO_4^{2-} = 58; NO_2^-= 92, and NH_4^+ = 95	(El Ghadraoui et al., 2020)

A full scale hybrid Constructed wetland was designed by (Ali et al., 2018) to treat the municipal wastewater and applied that treated water for irrigation purposes. The design of the hybrid constructed wetland was comprised of a vertical sub-surface flow constructed wetland and five phyto-treatment ponds. They concluded that after treatment through VSSF-CW the pollutants concentration decreased significantly still then the value of pollutant like phosphate, cadmium, chromium and potassium was not found to be under standard value fixed for the irrigation purposes. Thus, again the treated water was passed through the phyto-treatment ponds and they got success to match the water quality with the standard value prescribed for the irrigation purposes.

Kickuth Type Constructed wetlands are used especially in European countries in which cohesive soil is used as a medium for the vegetation growth and filtration unit' (CPCB, 2019).The municipal wastewater treatment for 10 year was analyzed by using sub-surface flow Kickuth type constructed wetland in Poland. During study (Mucha et al., 2018) observed that the efficiency of the wetland increased up-to 10 years from the initial year then the efficiency decreased and many problems like beds clogging evolved. They also observed that BOD, COD and TSS removal was quite satisfactory and performance slowed down after 12 years. Whereas, the system was unable to treat TP and TN significantly from the beginning of the study.

A study was done by Barco & Borin, 2017 to treat the municipal wastewater through a hybrid constructed wetland. During study they changed the macrophytes of the existing hybrid constructed wetland. The HCW was the combination of HSSF-CW (Horizontal Sub-surface Flow Constructed wetland) and FTW (Floating treatment Wetland). In past the existing HCW was planted with the vegetation like *Prunus laurocerasus, Laurus nobilis, Elaeagnus angustifolia* and *Pittosporum* spp *etc*. which were not wetland species and did not have capacity to treat the wastewater due to short root system and controlled evapotranspiration rates. They observed noteworthy performance of the HCW by changing the vegetation to *Phragmites australis, Iris pseudacorus.*

A coupled microbial fuel cell- constructed wetland was tested in lab scale for energy harness by treating municipal wastewater –(Tao et al., 2020). The integrated CW was installed inside a glass column having diameter 30cm and height 55cm. The column was packed with gravels of different size from bottom to top. The anode was inserted in the middle of the packing layer and cathode was inserted in the upper layer of the column where air and water boundary were occurred. To provide oxygen facility the upper layer was planted with water hyacinth. They found xylan as the best carbon source for microbial fuel cell. During their experiment they concluded that the mixture of glucose and xylan (40: 60) was the excellent carbon source to achieve TN removal up-to 88.78 ± 3.98% with average power density $3.8\ mW/m^2$.

A multistage constructed wetland consisting of two stages of vertical flow and one stage of horizontal flow was constructed by (Torrens et al., 2020) to treat the municipal wastewater for using that treated water in irrigation purposes in Senegal, which is a hot and arid climate zone. During this study they observed that uncrushed gravel and

Typha played major role in treating wastewater and pollutant removal. They conclude that as the treated water quality lied under the standard value given for the agricultural purposes, which was a bless in the area like Senegal.

Treatment of municipal wastewater by vertical flow constructed wetland has been studied worldwide. Choosing vegetation during the wastewater treatment through constructed wetland is one of the important and unavoidable part as it influences the treatment activity. performed a comparative study of the two plant species *Phragmites australis and Cyperus papyrus*. They evaluated by analysing physical, chemical and biological parameters for three consecutive months that *Cyperus papyrus* was very much potential to treat the municipal wastewater with significant removal efficiency.

A pilot scale study was done to treat the olive oil and municipal wastewater mixture through a VFCW. The system was comprised of PVC tank of height 0.60 m and surface area 0.24 m^2. The tank was filled by 30 cm of sand (0.25/0.40 mm) after that 10 cm of pozzolan (5/20 mm) and 10 cm of gravel (20/40 mm) from bottom to top. During the study pozzolan was introduced as a filing medium to enhance the removal efficiency for pollutants present in the wastewater mixture. They found that the system was capable to remove total phenolic compound (hydroxytyrosol, tyrosol, caffeic acid, P-caumaric acid, and cinnamic acid) present in the mixture only because of pozzolan. They also observed the quality of treated water matched with the Moroccan irrigation standard and could be applied for irrigation of cereal, industrial and fodder crops, pastures, and plantations trees.

CONCLUSION

This 21st century is a crucial period for all the inhabitants of the mother earth. Our changing life style, reckless behavior for the nature and her properties has turned our healthy surroundings intovenomous one. In our above discussion we have discussion we have discussed on wastewater and its treatment in a sustainable way. Taking sustainable treatment into account we have only focused on the pocket and eco-friendly technology that is constructed wetland. From the above discussion we may conclude that for municipal wastewater treatment, the major contributor of water pollution, we should follow constructed wetland. Our study showed that among various constructed wetland the excellent one with greater removal rate is multistage hybrid constructed wetland. Besides design, selection of substrate and vegetation, major part constructed wetland depends on the locality and geographical condition. The best and most important matter is that after treatment of wastewater in can be reused for various purposes which that we have mentioned above. In-addition to it energy harness is also possible by integration MFC with constructed wetland. For potable water we may treat that constructed wetland treated water through various advanced oxidation method like UV radiation, ozonation or membrane (nano, micro, reverse-osmosis). Overall discussion proved that constructed wetland is the best solution for municipal wastewater treatment from economic, environment, aesthetic, and space requirement aspects.

ACKNOWLEDGEMENTS

Authors sincerely acknowledge Director, CSIR-CSMCRI, for providing infrastructural facilities. This work was supported by the Science and Engineering Research Board (GOI) [The project grant/file no. SRG/2019/001803].

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International Journal on Environmental Sciences

International Journal on Environmental Sciences 13(1), January-June 2022, pp. 22-25
ISSN No.: 0976-4534

SOLID WASTE MANAGEMENT THROUGHOUT PANDEMIC COVID-19: CHALLENGES AND SOLUTIONS

Ashish Rana and Shailesh Kumar Gupta

Dept. of Electrical & Electronics Engg.
Raj Kumar Goel Institute of Technology, Ghaziabad (U.P.), India

Review Article

Received: **20.04.2022** Accepted: **29.04.2022** Published: **07.05.2022**

ABSTRACT

Wuhan City became the epicentre of the extremely infectious novel corona virus at the starting of January 2020. In terms of socioeconomic-environmental problems, the COVID-19 pandemic has produced a global emergency situation. Such a crisis has altered waste generation and disposal in both qualitative and quantitative ways, posing real challenges to policymakers in making decisions that will ensure environmental sustainability. People of all ages are disrupting their daily routines, which has resulted in a change in the waste produced by medical facilities and quarantine centres. The mandatory use of personal protective equipment such as masks, gloves, sanitizers, and other similar products by frontline staff in the medical sector, banks, daily need shops, waste management industries, and elsewhere, as well as the use of masks by any average person stepping out, has distorted the waste generation trend in a different direction. The current study attempts to reflect the difficulties that the current waste management system faces in combating massive waste generation. India ranks second in the world in terms of COVID positive cases, resulting in a massive increase in biomedical waste production. As a result, the current report has attempted to illustrate and address all of the emerging issues that have arisen as a result of the continuing global pandemic, as well as the importance of doing so.

Keywords: COVID-19 pandemic, Challenges, Solid waste management, Biomedical wastes.

INTRODUCTION

In urban India, solid waste management (SWM) has been one of the most important development problems. Owing to microbial decomposition, climate conditions, refuse characteristics, and land-filling activities, several studies have shown that improper waste disposal creates toxic gases and leachates. The COVID-19 pandemic has already wreaked havoc on the waste industry. As the pandemic was spreading and many countries were implementing lockdowns, municipal waste operators and public authorities were forced to quickly adapt their waste management systems and procedures to the situation. COVID-19 is a highly transmissible and pathogenic virus caused by the SARS-CoV-2 coronavirus (Hoque *et al.*, 2020; Rahman *et al.*, 2020; Kumari and Shukla, 2020). It showed severe effects on environment and society (Verma and Prakash, 2020a; Roy and Chaube, 2021). There is no way of knowing when this deadly pandemic will stop, and there are no safe therapeutic or preventive medicines available. The use of masks and other personal protective devices is thought to be one of the most viable ways to protect people from the virus. Medical waste (MW) associated with COVID-19 presents a new problem for developing countries with insufficient waste management systems.

Following the advent of COVID-19, the city of Wuhan in China saw a more than fivefold rise in MW generation (Islam *et al.*, 2020; Si and Li, 2021). Manila, Kuala Lumpur, Hanoi, Bangkok, and some UK cities all saw

*Corresponding author: *akshatgoel97@rkgit.edu.in, ranaashish533@gmail.com*

similar rises, generating 154 to 280 tons more MW per day than before the pandemic (ADB, 2020; COVID-19 waste survey results, 2020). Large number of wastes including e-wastes and medical wastes created by health-care activities have the potential to damage the global environment as well as human, domestic, and wild animal health if it is not properly managed (Stuart, 2019; Verma and Prakash, 2020b). MW-related diseases claim the lives of approximately 5.2 million people per year, including 4 million children (The Daily Star, 2020). According to a recent World Health Organization (WHO) survey, inappropriate waste management causes 25.0 percent of diseases in developing countries (Trivedi *et al.*, 2020). COVID-19 disease presents a danger to the spread of this extremely infectious disease due to improper waste management (Das *et al.*, 2020).

CHALLENGES

Prior to the COVID-19 pandemic, the world was already grappling with problems in the waste management market, with over two billion people lacking access to waste collection and over three billion lacking access to waste disposal. As a consequence, the advent of the COVID-19 pandemic, as well as the subsequent social distancing steps, exacerbates an already overburdened field. Throughout the COVID19 pandemic, mostly countries is confronted with a number of difficult issues that must be resolved immediately. These difficulties include the following:

1. Since the volume of domestic hazardous waste (DHW), which includes gloves, masks, and other products, is rising rapidly, there is a problem with collecting the waste separately.
2. Staff and sanitary workers are not given adequate training to deal with the general waste that is created during COVID-19.
3. The tracking, inspection, and verification systems in towns and villages are inadequate.
4. Waste treatment plant managers and employees are still in grave danger. Daily waste handling instruction for the operators is also a difficult problem.
5. The collection staff's chances of being contaminated may be increased if PPEs and disinfectants are not provided on a regular basis or if they are not provided at all.
6. Owing to a shortage of door-to-door collection personnel in many parts of the world, one-point collection has become the norm, raising the risk of contamination as residents congregate at a single venue.
7. Separate vehicles for transporting COVID-19 waste from homes/quarantine centres to the CBWTF, as well as chemicals to clean them.There's a risk the virus will spread if these vehicles are used to gather MSW without being disinfected.
8. The implementation of the CPCB guidelines and SBM advisory at the local level among residents and other waste-handling personnel.
9. According to SWM law, public information about the segregation of dry and wet waste, as well as domestic hazardous waste, cannot be given in weeks or months.
10. Infection will spread among sanitary workers if PPEs are not used and removed properly.
11. Maintaining social isolation in compliance with the standards at both collection centres and treatment plants.
12. Since the virus may be present in wastewater discharged from health-care facilities, operators and personnel working at wastewater treatment plants are at a large risk of infection.
13. Personnel involved in sludge management or wastewater treatment handling are often at risk of being polluted.
14. Site conditions in certain parts of the world necessitate manual loading or unloading of waste, raising the risk of pollution.

POSSIBLE SOLUTIONS

The sudden cessation of industrial and everyday operations impacted product production, resulting in the layoff of many workers, and shifted waste generation and collection patterns. Patients are overcrowding isolation facilities and hospitals, resulting in a vast volume of infectious waste. From health care to domestic levels, the demand for PPE kits, masks, hand sanitizers, gloves, and other items has increased at an unexpected pace, resulting in massive waste generation. Several countries have taken precautions to prevent the virus from spreading.

Therefore, the possible solutions which may be the:

1. Domestic hazardous materials should be disposed in yellow bags provided by ULBs and should not be mixed with other household waste during storage and collection by the collection authority.
2. Before using, the yellow bag containing the DHW should be thoroughly tested to ensure that it does not leak, and it should be kept out of the reach of children and pets.
3. Masks, gloves, and other personal protective equipment (PPE) produced during home quarantine should be stored in paper bags for a minimum of 72 hours before being disposed of as general waste or handed over to a sanitary worker.
4. A request to the Urban Local Bodies affiliated with solid waste management for an identifying

arrangement for the collection of DHW (both wet and dry waste created as home quarantine as SBM considers these waste as biomedical waste), and this waste should not be dumped near the locality or water source, or in open areas.

5. A separate team should be formed to collect COVID19 waste.
6. Just hand over this waste to an approved collector at the curb, if a collection system exists; if not, deposition centres for yellow bags have been created.
7. If an alternative arrangement is possible, contact the CBMWTF operator and have your waste delivered to your door.
8. People who generate DHW as a result of the home quarantine should contact ULB officials if they have any problems handling the waste.
9. The yellow bags and other services should be given by ULBs to the people who run Quarantine Camp and homecare providers.
10. Sanitary personnel should wear personal protective equipment (PPE) and sanitise it on a regular basis, and they should not touch anything with their bare hands (fleet/waste buckets, even plastics, cardboard, and steel, etc.).
11. Doctors and other health professionals can sanitize the equipment they use to treat patients.
12. Staff in the waste processing plant should be supplied with appropriate PPE and removal procedures.
13. People and sanitation workers should keep a safe distance of at least 6 feet between them.
14. If you have COVID19 symptoms, stay away from other people and work, and notify the appropriate people or boss at work.
15. The health care provider and sanitary worker should remove their PPEs according to procedure and thoroughly wash their hands, mouth, eyes, nose, and other body parts.
16. Vehicles used to process this waste should be sanitized with sodium hypochlorite on a regular basis.
17. After leaving the house, wash your hands and face thoroughly, and leave your shoes outside.
18. Before and after commissioning the work of workers employed in hospitals, group work, or waste disposal units, there should be a regular check-up.
19. A monitoring and analysis team should be established to oversee waste collection, processing, and care.
20. Health-care centres in India should be expanded, especially for COVID19.
21. If a patient is ambulatory, they can continue to use the nearby services. If the patient used a bedpan, solidify the excreta with super absorbent polymer gel granules before disposing of it as hospital waste.
22. The COVID19 waste bags should have a barcoding scheme that is correctly enforced.
23. Liquid chemical waste produced by quarantined person should not be deposited directly into the general wastewater; instead, it should be treated in an appropriate facility.
24. The CPCB recommendations under COVID19 should be strictly followed by local governments.
25. Community and social medicines should be emphasized and used properly (Balwan et al., 2021).
26. Before placing waste containers out for collection, the waste generator demands that they wash their hands. To further minimize visibility, sanitize or clean the handles and lids.
27. Do not place tissues, paper towels, wipes, masks, latex gloves, or any other sanitary or cleaning materials used to protect yourself from the Coronavirus in recycling carts or bins.
28. Before recycling, empty, clean, and dry your bottles, cans, and other containers.
29. Before recycling, empty, clean, and dry your bottles, cans, and other containers.

    (https://swana.org/docs/default-source/resources-documents/c19_guidelines-resident.pdf and

    https://nidm.gov.in/covid19/PDF/covid19/research/16.pdf)

CONCLUSION

The pandemic is predicted to last until 2030, according to the current scenario. As a result, a long-term solid waste management strategy is needed. The most important prerequisite is for people to be aware of how to deal with the current situation wisely. People must be concerned about the welfare of the frontline workers, as waste management is not solely the responsibility of the collector. As a result, the instruction to reduce waste generation is given. Countries have introduced strict and versatile waste disposal policies to prevent virus transmission through solid waste generated by households, self-isolated COVID patients, and hospitals as a result of changing conditions influencing waste collection and disposal.

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International Journal on Environmental Sciences

International Journal on Environmental Sciences 13(1), January-June 2022, pp. 26-29
ISSN No.: 0976-4534

A SHORT REVIEW ON NEW ENDEMIC *CHANNA AURANTIMACULATA* (TELEOSTEI: CHANNIDAE) OF BRAHMAPUTRA RIVER, ASSAM

Ashish Sahu

Department of Fisheries Resource Management, Faculty of Fisheries
Kerala University of Fisheries and Ocean Studies
Panangad, Cochin, Kerala, India

Short Communication

Received: **23.04.2022** Accepted: **30.04.2022** Published: **12.05.2022**

ABSTRACT

Channa aurantimaculata (Musikasinthorn, 2000), a new endemic murrel of the Brahmaputra basin, Assam, has significant economic importance in India as a food due to its exquisite taste and ornamental value. This species is commonly called Golden Cobra Snakehead or Orange Snakehead, which has brown marking along its back and sides characterized by blue veins on the top of its head and the rest of the body is golden in colour and blotched with blue. Fishermen and local people should be made aware to conserve this species. Spatial conservative management could be applied to maintain genetic diversity and to improve breeding technology.

Keywords: Orange-spotted snakehead, IUCN, Conservation, Biology, feeding habit.

INTRODUCTION

The snakeheads (Actinopterygii: Perciformes: Channidae) comprise more than 40 valid species in two genera; Channa, and Parachanna (Li et al., 2006; Serrao et al., 2014). The ray-finned fish- channais native to tropical Africa, parts of the Middle East, and Asia (Berra, 2001), and Parachanna in tropical Africa (Li et al., 2006). They are commonly known as "snakeheads" because of the possession of large cycloid scales on the head and ctenoid on the body, which is evocative of snakes; elongated cylindrical body; a large mouth with well-developed teeth on the jaws; vomer and palatines; and chiefly characterized by having long dorsal and anal fin bases with soft rays; rounded caudal fin; and curved lateral line (Musikasinthorn, 1998; Vishwanath & Geetakumari, 2009).They can survive out of water for short periods because of special adaption accessory respiratory organs (ARO), (modified epibranchial) situated in the suprabranchial cavity in the head.

The fairly large species,*C.aurantimaculata*, is an endemic murrel of the upper Brahmaputra river basin (Biswas, 2007), which is found in the forest streams, ponds, and swamps adjacent to the rainforest of northern Assam. The species is remarkably striking, with a vibrant pattern of purple and orange adorning the length of its body and it can be regarded as a potential aquarium fish. The fish was discovered in 2000 in Dibrugarh, Assam, and measures up to 40cm in length.The fish is also known as the 'orange-spotted snakehead', as its head looks like that of a snake. It is carnivorous and predatory, enjoying a diet of smaller fish and invertebrates. This species is listed in the data deficient category. However, due to its high market value, the species is captured indiscriminately, jeopardizing its very existence throughout its distributional range.

Etymology

The specific name, *C. aurantimaculata*, refers to the orange blotches (aurantium=orange, maculatus=blotch) on the sides of the body in the new species.

*Corresponding author: *sahu81862@gmail.com*

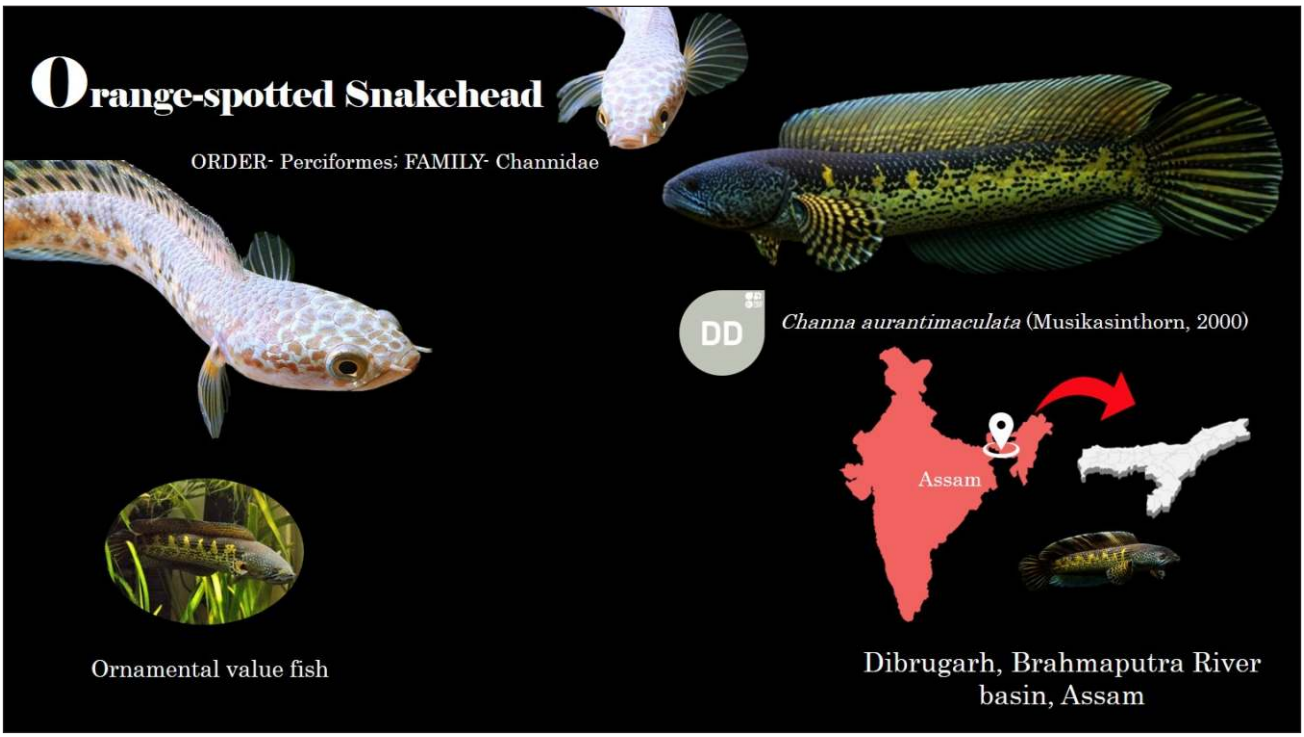

Fig. 2: *Channa aurantimaculata* (Illustration by Ashish Sahu)

Short description

The body is elongated and relatively slender, with a cross-section that is almost circular in the anterior portion and somewhat compressed in the posterior. Total dorsal soft rays: 45–47; Anal soft rays: 28–30; Lateral line scales: 51–54; Cheek scales: 8–12; Total vertebrae: 50–52; two large scales on each side of the lower jaw under surface; upper half of the body darkish brown to black with 7–8 large orange (white in alcohol-preserved specimens) irregular blotches; and 5 broad bright black bands.

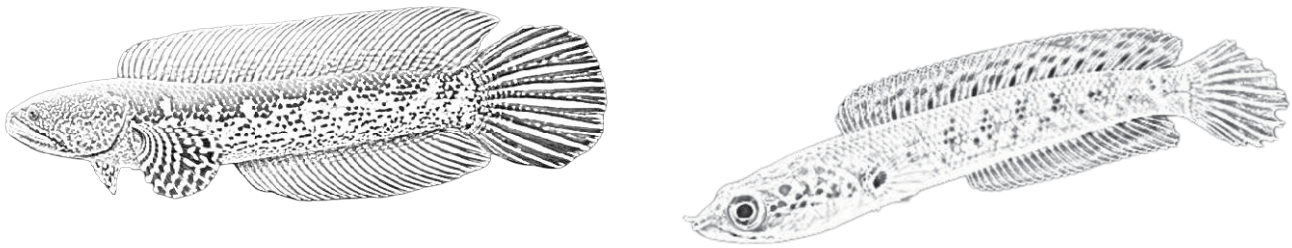

Fig. 2: *Channa aurantimaculata* (Illustration by Ashish Sahu).

Geographical distribution

It is endemicin the Brahmaputra River basin in Dibrugarh, Assam.

Habitat and ecology

Generally, they inhabit deep, clear lakes and rivers with rocky or sandy substrate, stagnant water, forest, hill streams, and swamps with submerged aquatic vegetation (Talwar and Jhingran, 1991) adjacent to the Brahmaputra river in subtropical rainforest conditions (Musikasinthorn, 2000). This species grows to 40 cm. It is a mouthbrooderlike most of the smaller snakeheads. It is probably carnivorous like other members of this genus.

Reproductive biology

Reproductive biology of female: There are five different maturity stages, based on their morphological structure, space occupied in the abdominal cavity by gonads and diameter of unspawned eggs.

Stage I (Immature): Ovaries are translucent, ribbon-like, and pale yellowish. Ova are not distinct to naked eyes.

Stage II (Maturing): Ovaries are more yellowish and thicker; ova was visible to naked eyes; under the microscope, ova is spherical, and covered ½ of the abdominal cavity.

Stage III (Mature): Ovaries are dark yellowish enlarged lobes with prominent ovules and blood vessels occupy ¾ of the body cavity, much broader than stages I and II.

Stage IV (Ripe): Ovaries are deep yellowish with maximum size; occupied the entire body cavity. Under the microscope, ova are spherical in shape and opaque due to the presence of a huge amount of yolk. At this stage, ova are of full size and started liberating through oviducts by putting light pressure on the abdomen.

Stage V (Spent): Ovaries flaccid, almost thread-like in appearance resembling matured Stage I ovary; reduced in size and volume, and became pale yellowish.

Reproductive biology of male: Similarly five matured stages are recognized in males based on the progression of the development of testis.

Stage I (Immature): Testis small; very fine thread-like and pale whitish in appearance.

Stage II (Maturing): Testisare pale whitish; 'V-shaped in structure; slightly increased in volume and weight and occupied about ¼ of the abdominal cavity.

Stage III (Mature): Testisare enlarged, and brush like structures; blood vessels were prominent; covered nearly ½ of the abdominal cavity.

Stage IV (Ripe): Testismore prominent and soft; blood vessels increased and milt ran with slight pressure on the abdomen.

Stage V (Spent): Testis shanked, reduced in size and weight and pale white.

Threats: Limited information available; the only confirmed exploitation is for the aquarium trade.

Disease: First time, Kavitha et al. (2014) reported the occurrence of ulcer disease in ornamental fish, *C. aurantimaculata*. The predominant presence of *Aeromonashydrophila* in naturally infected *C. aurantimaculata* insisted its principal role in ulcer disease in the ornamental.

Use and Trade: There are no threats, but they are known to be used as aquarium fish and likely captured in small numbers by local fishers for subsistence use.

Conservation actions: *C. aurantimaculata* has a localised population only known from northeastern, Assam and it is assessed as Data Deficient (IUCN, 2017). Further information is required on the species, habitat, ecology and distribution.

IUCN status: Data Deficient (DD); **CITES:** Not Evaluated (NE); **CMS:** Not Evaluated (NE)

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International Journal on Environmental Sciences

International Journal on Environmental Sciences 13(1), January-June 2022, pp. 30-34
ISSN No.: 0976-4534

GROUNDWATER POLLUTION DUE TO NITRATE, ASSOCIATED HUMAN HEALTH IMPACT AND POTENTIAL HEALTH RISK ASSESSMENT

Abhishek Singh[1], Virendra Verma[2], Brijesh Kumar Yadav[3], Vinod Kumar Chaudhary[3]*

[1]Department of Mathematics and Statistics, Dr. Rammanohar Lohia Avadh University, Ayodhya, India
[2]Department of Medicine, Rajarish Dasrath Autonomous State Medical College Society Ayodhya, Faizabad, India
[3]Department of Environmental Sciences, Dr. Rammanohar Lohia Avadh University, Ayodhya, India

Research Paper

Received: **28.04.2022** Accepted: **08.05.2022** Published: **17.05.2022**

ABSTRACT

Level of nitrate in our water bodies is increasing at a very fast rate not only in India but throughout the globe. The reason for increase is related to over use of fertilizers and discards from the cities and industries. Consumption of high concentration nitrate water leads to several health disorders in humans including; methemoglobinemia, thyroid, cancer, blood pressure, diabetes etc. In order to prevent from the ill effect of nitrate various research organisations around the globe had established maximum permissible limit that can be allowed in water supply as above which required steps should be performed to remove the excess concentration. In order to prevent the human being from the further ill effects on exposure to nitrate further risk assessment can be performed.

Keywords: Methemoglobinemia; Risk Assessment, Groundwater pollution, Cancer, Thyroid.

INTRODUCTION

Water is considered as one of the vital resources required for existence of any form of life on planet earth. Nearly 70.9% of the Earth's surface is covered with water out of which majority is found in oceans (96.5%) while groundwater covers 1.7% and rest is present in form of glaciers and in air in the form of clouds and vapor etc. (Gleick, 1993). Out of the total availability of water resource only 2.5 is considered as fresh. In last few decades availability of safe drinking water has improved a lot but still enormous number of people (nearly one billion) are still missing it. According to a research performed by Kulshreshtha it had been reported that nearly half of the population around the globe will be facing problems related to water by 2025 (Kulshreshtha, 1998). In recent years, crisis of water in various parts of the world has become one of the important issue and hence it had gained enormous attention form the researchers around the globe in order to find and develop the sustainable sources of fresh water (Mossad and Zou, 2013). Water Pollution is becoming one of the major reason for health disorder among humans and nearly 2.3 billon people are facing some sort of illness due it (UNESCO, 2003; Kalal et al., 2021). According to reports by international organisations, it had been founded consumption of polluted water is cause of death to more than 2 million people in developing countries (Azizullah et al., 2011).Groundwater, because of its purity, is considered as one of most important source of portable water. With advancement in techniques and excessive use of nitrogenous fertilizers in the crop field's quality of groundwater has deteriorated significantly (Roo1980; Schepers at al., 1984). The level of nitrate in water is not only elevated due to excessive use of fertilizers but also due to improper disposal of municipal and

*Corresponding author: *vinodkrchaudhary@gmail.com*

industrial waste. These anthropogenic activities cause several serious environmental issues including; biodiversity threats, eutrophication, health issues in animals and humans (Prakash and Verma, 2022). Growth of algae and other aquatic plants will prove to be disastrous to fish and other aquatic species (Camargo and Alonso, 2006). Nitrate, because of high solubility and low retention in soil, it filters to subsoil and hence mixing with the groundwater (Stevenson, 1986).High level of nitrate in groundwater is mainly due to enormous waste generation due to urbanization and industrialisation (Handa, 1983). Consumption of groundwater having high nitrate concentration leads to several health disorders like methemoglobinaemia in child and cancer in adults mainly stomach (Fewtrell, 2004; Pennington, 1998; Chiu et al., 2007).In order to manage and control the ill effects due to presence of excessive nitrate in groundwater various regulatory bodies around the globe had established limit of nitrate concentration in water. The maximum allowable limit of nitrate recommended by India, WHO, USEPA, EU, Australia, and South Africa are 45, 50, 45, 50, 50, and 20 mg/l respectively (BIS: 10500, 2012; WHO, 2008; USEPA 2009; EU 2007; National Health and Medical Research Council, 2011; Masukume et al., 2011). Removal of nitrate from the water is little bit difficult by conventional water treatment methods as it show poor precipitation and adsorption tendency mainly due to higher stability and solubility (Islam et al., 2010). In recent years various technologies employed for removal of nitrate from water includes; electrodialysis, adsorption, denitrification, ion exchange, reverse osmosis, and biological etc. (Canter, 1997, Soares, 2000, Schoeman and Steyn, 2003, Öztürk and Bektas¸ 2004; Zhan et al., 2011, Bhatnagar and Sillanpää, 2011, Abou-Shadyet al., 2012). Adsorption of nitrate, because convenience, operation, cost effectiveness, simpler design and easy and cheap regeneration techniques, makes it one of the most attractive method for treatment of contaminated water (Khan et al., 2011).

Nitrate Associated human health Impact

Nitrate in humans can enter via dermal, oral or by inhalation. The presence of nitrate above permissible limit may lead to several health disorders. The effect of nitrate may be acute, intermediate or chronic. Presence of nitrate above permissible limit in infants leads to methemoglobinemia disease. In this consumed nitrate gets converted in to nitrite in the mouth by bacteria that further binds with haemoglobin and forms methemoglobin, resulting in the reduction of the oxygen carrying capacity of the blood. This becomes life threating if the methemoglobin presence becomes more than 10 % (Ward et al., 2005; Greer et al., 2005). Nitrate consumption above permissible limit may also lead to pregnancy failure including prematurity, neonatal deaths, low birth weight and fetal death etc. (Ward et al., 2005). Ingestion of nitrate in higher concentration may leads to thyroid, stomach cancer, childhood diabetes, disease related to respiratory tract, blood pressure, myocardial infarction and heart failure etc (Ahluwalia et al., 2016; Kapil et al., 2015; Omar et al., 2015; De Groef., 2006; Van Maanen et al., 1996).

Exposure assessment

The main importance of exposure assessment is to develop exposure assessment model for predicting the risk associated with it by using factors like exposure pathway, exposure age group, exposure magnitude and frequency and the duration for which the person is exposed to the contaminated system. The recommended pathway of exposure for environmental medium incudes; air, water, soil, and food. Either Ingestion or dermal absorption are the major pathway via which nitrate reaches to human body. Therefore, in order to analyse the risk of exposure there is need to determine the daily absorbed dose (DAD) and chronic daily intake (CDI) in a human by using certain formulas.

DAD is used to find the quantity of the potentially health hazardous chemical across the skin per day in to the human body and it is calculated in mg/kg per day. The formula used for this was provided by USEPA [USEPA 2004].

$$DAD = \frac{C_w \times K_i \times SA \times EF \times ED \times EV \times CF}{BW \times AT}$$

Where,

DAD= daily absorbed dose (mg/kg per day)

Ki= Dermal adsorption parameter (cm/h)

SA=skin surface area available for contact (cm2/event)

EF=Exposure frequency (days/year)

ED = Exposure duration (year)

EV= bathing frequency (times/day)

CF=conversion factor (L/cm3);

BW= average body weight, (kg)

AT= averaging time (days) (AT = EF x ED)

CDI, an important aspect for estimating the potential risk by the contaminants discarded in the environment on human body by drinking of water. Formula given by USEPA, can be used for the calculation of CDI [USEPA 1991].

$$CDI = \frac{C_w \times DI \times EF \times ED}{BW \times AT}$$

Where,

CDI= chronic daily intake (mg/kg per day)
CW = contaminant concentration in the water, (mg/L)
DI= daily intake of water (L/day)
EF= Exposure frequency (days/year)

ED= average exposure duration in a lifetime, (Year)
BW= average body weight, (kg)
AT = averaging time (days) (AT = EF x ED).

Risk characterization

Risk Characterisation is one of the utmost important and last step in health risk assessment. The data obtained by using the previous steps are used to analyse the overall situation so that a better conclusion with clear information can be obtained and hence can be helpful in decision making [Fowle and Dearfield, 2000].

The hazard quotient is calculated to represent the possible hazard of nitrate in water (both by drinking water and by dermal contact pathways) for human health risk assessment. The following formula is used for the calculation of hazard quotient

$$HQ_0 = CDI / RfD_0$$

Where,0*HQ*= Noncarcinogenic hazard quotient of the drinking water pathway, unitless
CDI= Chronic daily intake (mg/kg day)0*RfD*= Nitrate reference dose of the drinking water pathway (mg/kg day).

Hazard quotient formula for dermal contact is given as;

$$HQ_d = DAD / RfD_d$$

Where,

HQ_d= Non-carcinogenic hazard quotient of the dermal contact pathway, unitless

DAD= Daily absorbed dose (mg/kg day)

RfD_d= nitrate reference dose of the dermal contact pathway (mg/kg day)

The overall hazard quotient for health risk assessment can be calculated by linear superposition of HQ_O and HQ_d, which can be shown as;

$$HD = HQ_0 + HQ_d \; HD = HQ_0 + HQ_d$$

Where, HD is the total hazard quotient for the human health risk assessment, and it unit less.

CONCLUSION

With rapid industrialisation, urbanisation and population overutilization of nitrogenous fertilizers and disposal of municipal and industrial waste had increased immensely. This became one of the most important reason for increase in the concentration of nitrate in groundwater. Consumption of the water with high amount of nitrate leads to several health related issues in human beings. Hence various international organisation around the globe had established maximum allowable limit of nitrate in water so that on consumption it would pose no further health effect. Health risk assessment had been being explained in order to calculate the possible health impact in human being based on dose, route of exposure and contact duration. So that necessary action should be taken in order to prevent from ill effects on exposure.

ACKNOWLEDGEMENT

Authors acknowledge the cooperation and assistance received from Dr. Rammanohar Lohia Avadh University, Ayodhya.

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International Journal on Environmental Sciences

International Journal on Environmental Sciences 13(1), January-June 2022, pp. 35-42
ISSN No.: 0976-4534

STATUS OF PLANT BIODIVERSITY IN WAGHUR RIVER BASIN OF KHANDESH REGION IN MAHARASHTRA

Abhijit S. Thorat[1], Shridhar K. Jadhav[2] and S. R. Thorat[3]

[1,2,3]School of Environmental and Earth Sciences
Kavayitri Bahinabai Chaudhari North Maharashtra University Jalgaon, Maharashtra

Research Article

Received: **18.05.2022** Accepted: **28.05.2022** Published: **07.06.2022**

ABSTRACT

River and its basin biodiversity are the economical and natural value of Planet Earth are with a rich diversity of life forms, and millions of these living organisms have been well attached by the laws of nature. Plant on the river basin shows its characteristics and regional specification of the climatic system. A study was conducted to assess the status of biodiversity in the submergence zone of Waghur river near Jalgaon in this point of view of ecological components and their biological value. The richness of plant community and diversity study involves the study of species richness, diversity, and land-usepatterns. The present study shows the vegetation represents dry deciduous types, River basin area found 150 plant species were identified of their 30 tree species, 20 shrub species, 80 herb species, and 20 climbers were recorded from the river basin of Waghur

Keywords: Plant Biodiversity, Waghur River Basin, Waghur, Land Pattern, Species.

INTRODUCTION

The river basin is one of the majors diversify and species richness of flora, fauna, birds, and all types of biodiversity it's also economical value to the sustainable development of that area. Human life base of the current global food supply is depending on phenotypical variety of plant species and genotypes with genetic constitution characteristics for cultivation and human nutrition by early farmers (Ebert. et al., 2020).In the recent years, new disputes have reached for the conservation of useful genes for agriculture. Enhanced stress on Sensitive land resources has created a broad threat to biodiversity. As well the Species richness has become a valuable factor of biodiversity estimation. global biodiversity is very often considered in terms of global number of species in each of the different taxonomic groups ((Pullaiah et. al., 2015; Chavan et. al., 2018). India's mega biodiversity countries of the world, holding nearly 7-8% of the recorded species of the world, as well as 4 of the 34 globally identified biodiversity hotspots (Himalaya, Indo-Burma, Western Ghats and Sri Lanka, Sunderland). Traditional knowledge of biodiversity is the glory of Indian over 91,200 species of animals and 45,500 species of plants have been recorded in the ten biogeographic zones of the country (Rao. et al., 2010; Sonawane et al., 2008). In species richness and endemism, India is top position, its more than 300 wild ancestor plants and the diversity of crop plants is the highest. The biodiversity of plants is the genetic wealth of a country. Farmstead represents a land-use pattern involving deliberate management of multipurpose trees and shrubs in intimate association with seasonal vegetables (Fernandes and Nair,1990; Gaikwad and Thorat, 2004). Plant biodiversity of planet Earth is significantly exposer in composition from any that its ancestors would have experienced. Fluctuations in the intensity of the major greenhouse gases (CO_2, CH_4, N_2O) are air-borne pollutants that can also impact plant diversity (Corlett, 2014b). Recent century much interest has been given to diversity

*Corresponding author: *abhi11855@gmail.com*

conservation and utilization. Plant biodiversity is an important component of total biodiversity. It has been projected that there exist 5-30 million species of living forms on the Earth, of which 1.5 million have been recognized involving 300.000 plant species (Agrawal. 1999; Sheejan and Thorat 2016). The of occurrence of a particular species in an area is one of the clues of its biodiversity in that area (Haque. et al., 2015).

A study was conducted to assess the status of biodiversity in the submergence zone of waghur river near Jalgaon. In this study, various ecological components were studied for their biological value. It involved studying the richness of plant community, avifauna, aquatic fauna, and mammalian diversity. Biodiversity study involves studying species richness, diversity, and land use pattern of a biological community. Species richness refers to the total number of species, diversity refers to the number and abundance of different species and rarity refers to the total abundance of individual species in the area. For this study emphasis was given on the land use pattern and to find out how many rare, common, and uncommon species are found in the area.

MATERIAL AND METHODS

Methods used to know plant diversity of Waghur river basin: To understand the floristic diversity in the region, a transect consisting of alternate 20 x 20 m quadrats was used for sampling the habitat. Transect length depended on the species composition and diversity. All the trees at or above 10cm diameter at breast height (DBH) on 30cm girth at breast height (GBH) were enumerated at 1.3 meters above ground, identified, or samples collector (whenever possible). If field identification was not possible then it pressed for herbaria for future identification. Additional characteristics like aerophytes, climbers, parasites, any disturbance like lopping, logging, etc., were also noted. Canopy cover was noted, and ground litter quantity was weighed. Shrubs (GBH < 30cm and height >1m) were enumerated in two shrubs quadrates of 5 x 5 m laid diagonally inside 20 x 20m quadrates. Inside each shrub quadrate two 1 x 1m herb plotted (height < 1m) were laid diagonally and studied. Also, information such as ground control using a Global Positioning System (GPS), name of the locality, range of human activities such as lopping, logging, non-timber forest produces (NTFTP), fuel, and litter collections, fire incident, grazing, etc. were noted down. The photographs of different plant species have been presented systematically on the photo sheet in the result and discussion section.

Methods Used: Two methods were used to study in the plant community in waghur river basin is as follows.

- Stratified random sampling technique: In this form of sampling segment is stratified into several sub-segments within these areas.
- Quadrates sampling techniques: this technique involves quantifying vegetation in a non-grid of known measurement.
- Measuring trees and shrubs by plotting quadrates 10 x 10 meter, A1 x 1 meter quadrate was used for herbaceous vegetation sampling.
- All experiments were used for sampling river basin vegetation. In this process, the parameters noted are as follows.
- Species and number of trees, shrubs, herbs, and grasses
- Height and girth at breast height of trees.
- Phenophase (fruiting or flowering stage) of the trees, shrubs, herbs, and grasses

RESULT AND DISCUSSION

During the field study, 150 plant species were identified of their 30 tree species, 20 shrub species, 80 herb species, and 20 climbers were recorded from the river basin of waghur during Feb. 2018 to Jan 2020. The vegetation represents dry deciduous forest. Trees species such as Palash (local name) were the most dominant with associate species such as Arjun, Beheda. Dhooda species were the most dominant. The result obtained for plant species is presented in Table no 1.

Land Use Pattern: Recently increase in areas under non-Agricultural uses was due to a sharp increase in the population of the state. A substantial area from forest area has been put to non-agricultural uses causing negative growth in forest area for the entire study period. Further, it was observed that there has been a higher concentration for land under misc. trees, groves, barren and unculturable land, and land put to non-agricultural uses (Dekha et. al., 2018).

Forest land: The forest in waghur river basin area was dry deciduous with some semi-evergreen elements. The forests have a very poor diversity of trees and shrubs as per the result shown table no 1. The most dominant species was *Cordia dichotoma.* Other associate tree species were *Zizhyphus Mounatina* and *Lemmelia Belleena* the average height was measured up to 10 meters.

The study shows ground flora is abundant especially in the winter season with greater diversity. 15 grass species were recorded among which *Chrysopogon Spp*. was dominant. 39 species of the herb were recorded from the area. Species such as *Cassia tora, Indigofera trio, Evolvulus Alsionoides, Justicia Spp, Tephrosia Villosa, Vernonea Spp* were more common. Apart from this herb such as *Carallumaadscendens* were noted as rare in waghur area. In the case of the climber, six climbers *spp* were recorded

among which *Ampelocicus latifolia* was dominant whereas *Gloriosa superba* was rare to this area. Liana like *Butea Superba* has been recorded as shown in the table no 1.

Cultivated fields: According to the locals, part of the land could yield crops throughout the year whereas in some parts the yield was seasonal and water fed. The main crop of this area is cotton, bajara, and jawar. Along with this wheat, udad, chawli, moong, pea and tomatoes were cultivated. At places, there were banana and guvava orchards also. These crops were supplied water from the bore wells owned by the farmers. There was a small patch of teak *(Tectona Grandis*) plantation on some fields.

Wastelands: This area was intermixed with the crop fields, grassland, and forest land in the patches. This area showed signs of frequent grazing. The trees were stunted in growth with an open canopy. The area represents typically bioedaphic forest *i.e.*, dominance of *Butea Monosperma* Spp. Other associate species were *Terminalia Arjuna, Phonix Sylvestris, Cordia Dichotoma, Accacia Nilotica, Accacia Leocophloea, Zizipus Mauritiana,* and *Anogeissus Latifolia*. Grasses such as *CoixSpp* and *Chrysopogon Spp* were common in this area as.

Open water area: The east, left and right bank of Waghur River were studied for floristic diversity. This area also had a very sparse tree and shrub growth and abundant flora. In the study area 24 herbs species recorded. Dominant species among them were *Sida cordial*, *Sopubiadelphinifolio,* and *Acanthospermunmhispidium*. 9 species of climber were recorded in the area such as *Hemidesmus Indicus* and *Cyclea Peltata* was common. Amongst the shrubs most common were *Lantana camara, Cassia auriculata,* and *Maytenusheyneaa*. 15 trees species were recorded from the area. The dominant among them includes *Butea monosperma, Accacia nilotica, Terminalia crenulate, Morindapubscems,* and *Azadircta indica*. There was no natural tree growth near the village the species such as *Ailanthus excels* and *Azadirchta indica* were recorded. As expected, there were shrubs and climbers near the houses of the village. The observations made during the biodiversity survey are described in the subsequent points;

- The area studied of the river waghur basin does not show the presence of any endemic or endangered plant species. A detailed list of plants studied, and their status is given below in the table.
- As per the records, 393.51 ha of forest area were under submergence. However, the study revealed that a very low percentage of the area can be classified as forest area.

CONCLUSION

Table 1: Showing list of plant species in the entire study area.

Plant Species	Family	Type	Abundance
Abelmoschus manihot (L.) Medic	*Malvaceae*	Herb	F
Abelmoschus pannosum (Forst.f) Schlect	*Malvaceae*	Tree	F
Abitulon indicum (L.) sweet	*Malvaceae*	Tree	C
Acacia chundra (Roxb ex. Rottle) wild	*Mimosaceae*	Tree	C
Acacia leucophloea (Roxb.) wild	*Mimosaceae*	Tree	C
Acacia nilotica (L.) spp indica (bth.) Brenam	*Mimosaceae*	Tree	F
Acalypha malbarica Muell-Arg	*Euphorbiaceae*	Herb	VC
Acanthosprmumhispidum DC.	*Asteraceae*	Herb	C
Achyranthes aspera L.	*Amaranthaceae*	Herb	R
Aegle maemelos (L) DC.	*Rutaceae*	Tree	R
Alternanthera sessile (L) DC.	*Amaranthaceae*	Herb	C
Alysicarpous tetragonolobus Edgew.	*Fabaceae*	Herb	C
Ampelociccus latifolia (Roxb.) planch	*Vitaceae*	Climber	VC
Andropogon pumilus Roxb.	*Poaceae*	Herb	VC
Anogeissus latifolia (Roxb ex DC) wall	*Combretaceae*	Tree	C
Apludamutica L.	*Poaceae*	Herb	VC
Areva lantana (L.) A. L. Juss	*Amaranthaceae*	Herb	C

Argyreia sericea Dalz.	*Convolvulaceae*	Climber	F
Aristida adscensionis L.	*Poaceae*	Herb	VC
Azadirchta indica (L.)Delile	*Meliaceae*	Tree	C
Azanza lampas Alef.	*Malvaceae*	Herb	R
Balanites aegyptiaca (L.) Delile	*Balanitaceae*	Shrub	VC
Barlerialawii T.	*Acanthaceae*	Herb	C
Bauhinia racemosa lam.	*Caesalpinaceae*	Herb	C
Biophytumsensitivum DC.	*oxylidaceae*	Herb	VC
Boerhaviadiffusa L.	*Nyctaginaceae*	Herb	VC
Boswellia serrata Roxb. Ex colebr	*Burseraceae*	Tree	C
Brachiarariaeruciformis (J.E.Sm) Erseb	*Poaceae*	Hreb	VC
Bridelia retusa (L.) Spr.	*Euphorbiaceae*	Tree	C
Butea monosperma (Lam.) Taub	*Fabaceae*	Tree	VC
Butea superb Roxb.	*Fabaceae*	Climber	R
Caesaria elliptica Willd	*Flacourtiaceae*	shrub	F
Caesuliaaxillaris Roxb.	*Asteraceae*	Herb	F
Calatropisprocera (alit) R. Br.	*Asclepiadaceae*	shrub	R
Capparis decisua (Forsk.) edgeworth	*Cappariaceae*	Shrub	F
Capparius spinosa L	*Cappariaceae*	Shrub	F
Carallumaadscendens (Roxb.) R. Br	*Asclepiadaceae*	Herb	R
Cardiospermum microcarpa Kunth	*Sapindaceae*	Climber	F
Cassia auriculata L.	*Caesalpinaceae*	Shrub	VC
Cassia fistula L.	*Caesalpinaceae*	Tree	R
Cassia Pumila Lam.	*Caesalpinaceae*	Herb	VC
Cassia tora L.	*Caesalpinaceae*	Herb	VC
Cayratiatrifolia (L.) Domin	*vitaceae*	Climber	F
Celastruspaniculatus Wild.	*Celastraceae*	Climber	F
Chloris barbata Swartz.	*Poaceae*	Herb	C
Cissus woodrowii Santapau	*Vitaceae*	Climber	C
Cleome monophylla L.	*Cleomaceae*	Herb	C
Cleome viscosa L.	*Cleomaceae*	Herb	C
Cocculus hirsutus (L.) Diels	*Menispermaceae*	Herb	C
Coixgangantea Koen ex Roxb	*Poaceae*	Herb	VC
Commelina benghalnesis L.	*commelinaceae*	Herb	C
Corchorus aestuans L.	*Tiliaceae*	Herb	C
Cordia dichotoma Frostf.	*Cordiaceae*	Tree	C
Crysopogan fulvus (Spr.) Chiov.	*Poaceae*	Herb	VC
Cycleapeltata (Lam.) Hook and Thoms.	*Menispermaceae*	Climber	R
Cynodondactylon pers.	*Poaceae*	Herb	F
Cyperus rubicundusvahl.	*Cyperaceae*	Herb	F

Desmodiumheterocarpum (L.) DC.	*Fabaceae*	Herb	C
Desmodiumgangeticum (L.) DC	*Fabaceae*	Herb	C
Discoriabulbifera L.	*Dioscoraceae*	Herb	C
Discoria pentaphylla L.	*Dioscoraceae*	Climber	R
Diospyros melanoxylon Roxb.	*Ebenaceae*	Tree	C
Diplocyclospalmatus (L.) C. Jeffry	*Cucurbitaceae*	Climber	F
Dolichandrone falcate Seem.	*Bignoniaceae*	Tree	R
Duranta spp.	*Verbenaceae*	Shrub	F
Elephantopusscaber L.	*Asteraceae*	Herb	R
Eluesineindica (L.)	*Poaceae*	Herb	R
Eluesineindica (L.) Gaertn.	*Poaceae*	Herb	C
Enicostemaaxillare (Lam.) Raynal	*Gentianaceae*	Herb	C
Euphorbia thymifolia L.	*Euphorbiaceae*	Herb	C
Euphorbia geniculata Orteg.	*Euphorbiaceae*	Herb	C
Evolvulusalsinoides (L.) L.	*Convolvulaceae*	Herb	VC
Flacoutia indica (Burm.f.) Merr.	*Flacourtiaceae*	Shrub	F
Gloriosa superb L.	*Liliaceae*	Climber	R
Grewia tiliaefolia var tiliaefolia Vahl.	*Tiliaceae*	Shrub	C
Helicteresisora L.	*Sterculiaceae*	Shrub	F
Hemidesmus indicus (L.) Schultes	*Asclepiadaceae*	Climber	F
Heteropogoncontortus (L.) P. Beauv.	*Poceae*	Herb	C
Indigofera linifolia (L.f.) Retz.	*Fabaceae*	Herb	VC
Indigofera triata L.	*Fabaceae*	Herb	VC
Ipomea eriocarpa R.Br.	*convolvulaceae*	Climber	F
Ipomea mauritiana Jacq.	*convolvulaceae*	Climber	F
Justicia quinqueangularis var peploides Koen.	*Acanthaceae*	Herb	VC
Justicia simplx D.	*Acanthaceae*	Herb	VC
Lagaceamollis Cav.	*Asteraceae*	Herb	F
Lanneacoromandelica (Haut.) Merrill	*Anacardiaceae*	Tree	F
Lantana camara var. aculeate (L.) Moldenke	*Verbanceae*	Shrub	C
Lepidagathis cristata Willd	*Acanthaceae*	Herb	R
Leucas cephalotes (Roxb.) Spr.	*Lamiaceae*	Herb	C
Leucas zeylanica (L.) R. Br.	*Lamiaceae*	Herb	C
Luffa acutangula (L.) Roxb. Var amara (Roxb) C.B.C.L	*Cucurbitaceae*	Climber	R
Malva coromandeliana L.	*Malvaceae*	Herb	R
Mangifera indica L.	*Anacardiaceae*	Tree	C
Maytenusheyneana (Roth) Raju and Babu	*Celastraceae*	Shrub	VC
Melanocenchrisjacquemontii Jaub.	*Poaceae*	Herb	VC
Mimosa hamata Wild	*Mimosaceae*	shrub	C
Mitragynaparvifolia (Roxb.) Korth.	*Rubiaceae*	Tree	C

Morindapubescens J.E. Sm.	*Rubiaceae*	Tree	C
Moringa concanesis Nimmo	*Moringaceae*	Tree	C
Mucuna pruriens (L.) DC.	*Fabaceae*	Climber	R
Neonitisrheedii (Wall ex Wight and Arn.) W.H. Lewis	*Rubiaceae*	Herb	F
Opuntia spp.	*Euphorbiaceae*	Shrub	R
Orthosiphon pallidus Royle ex Bth	*Lamiaceae*	Herb	C
Oscimumgratissium L.	*Lamiaceae*	Herb	C
Oxalis carniculata L.	*Oxylidaceae*	Herb	C
Panicum notatum Retz.	*Poaceae*	Herb	C
Parthenium hysterophorus L.	*Asteraceae*	Herb	C
Phonix sylvestris (L.) Roxb.	*Asteraceae*	Tree	F
Phyllanthus fraternus Webster	*Euphorbiaceae*	Herb	C
Plumbago zeylanica L.	*Plumbaginaceae*	Herb	C
Pulicariawightiana (DC.) C. B. Cl.	*Asteraceae*	Herb	C
Pupalialappacea (L.) A. L Juss	*Amaranthaceae*	Herb	C
Rhynchosiarothi Bth ex Ait.	*Fabaceae*	Herb	R
Scrophulariachinesis L.	*Scrophulariaceae*	Herb	F
Senecio dalzellii C. B. Cl	*Asteraceae*	Herb	C
Sida cordata (Burm. f.) Borssum	*Malvaceae*	Herb	C
Sida spinosa L.	*Malvaceae*	Herb	C
Sitaria pumila (poir) R and S	*Poaceae*	Herb	VC
Solanum nigrum L.	*Solanaceae*	Herb	F
Sopubiadelphinifolia (L.) D. Don	*Scrophulariaceae*	Herb	C
Spermacocepusilla Wall	*Rubiaceae*	Herb	VC
Spoindios pinnata (L.f.) Rurz.	*Anacardiaceae*	Tree	R
Sporobolus coromandelianus (Retz.) Kunth	*Poaceae*	Herb	C
Tamarixericoides Rottl	*tamaricaceae*	herb	C
Tectona grandis L.	*Verbenaceae*	Tree	C
Tephorsiavillosa (L.) pers.	*Fabaceae*	Herb	VC
Terminalia arjuna (Roxb ex DC.) Wight &Arn	*Combretaceae*	Tree	C
Terminalia bellerica (Gaertn.) Roxb.	*Combretaceae*	Tree	C
Terminalia crenulata Roth.	*Combretaceae*	Tree	F
Themeda quadrivalvis (L.) O.Ktze	*Poceae*	Herb	C
Tragia involucrate L.	*Euphorbiaceae*	Climber	F
Tribulus terrestris L. H.	*Zygophyllaceae*	Herb	C
Tricodesma indicum (L.) R. Br.	*Boranginaceae*	Herb	C
Tridax procumbens L.	*Asteraceae*	Herb	C
Triumphetta rotundifolia L.	*Tilaceae*	Herb	VC
Triumphettapilosa Roth	*Tilaceae*	Herb	C
Tylophoradalzellii	*Asclepiadaceae*	Herb	C

Var fimbriata (Wall.) Grav and Mayur	*Asclepiadaceae*	Herb	C
Vernonia cinerea (L.) less	*Asteraceae*	Herb	C
Vigna trilobata (L.)Verdc.	*Fabaceae*	Herb	C
Vitex nifundo L	*Verbenaceae*	Shrub	C
Wrightia tinctoria (Roxb.) R. Br.	*Apocynaceae*	Tree	R
Xanthium strumarium L.	*Asteraceae*	Herb	VC
Zizipusmauritiana Lamk.	*Rhamnaceae*	Tree	C
Zizipus rugosa Lamk.	*Rhamnaceae*	Tree	R

Abundance code: C= common, F= Frequent, VC= very common, R= rare

A study was conducted to assess the status of biodiversity in the submergence zone of Waghur basin near Jalgaon. In the present study, various ecological components were studied for their biological value. It involved studying the richness of plant community, avifauna, aquatic fauna diversity. The vegetation of any area and the habitat types found there is a principal determining factor in the biodiversity of an area. The dominant vegetation type in the submergence area is agricultural fields. However, these do not have varied biodiversity from the point of view of vegetation. They support bird communities akin to grassland birds and such as wren-warblers, munias and pipits.

The diversity of other biotic components in this area is also not very high. The other main habitat types are scrub, grassland, open forest, and rivera in forest. The scrub forest and grassland are a result of the degradation of the forests and are kept in that state by biotic factors such as lopping and grazing. Scrub and seasonal grassland of the type found in the study area is a common habitat found in degraded areas and wasteland all over peninsular India. So, it cannot be said to be a very valuable area from a biodiversity point of view. The forests are of dry deciduous type. They are also considerably degraded by lopping and cutting and show no structural complexity in terms of vegetation layers. These forests are dominated by *Butea monosperma*. Some vegetation diversity in the forest was found only in a small patch in the Gangapuri area.

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International Journal on Environmental Sciences

International Journal on Environmental Sciences 13(1), January-June 2022, pp. 43-48
https://doi.org/10.53390/
ISSN No.: 0976-4534

EFFECTS OF CLIMATE CHANGE ON ECOSYSTEM AND BIODIVERSITY: A REVIEW

Ranjit Singh[1] and Alka Kushwaha[2]*

[1]Department of Botany, D.S.N. (PG) College Unnao (U.P.)
[2]Department of Botany, D.A.V. College Kanpur (U.P.)

Review Article

Received: **18.05.2022** Accepted: **28.05.2022** Published: **07.06.2022**

ABSTRACT

Anthropogenic activities have changed the global climate since last few decades. This climate change adversely affected the biological resources of the country. This review basically discuss on the climate change, biodiversity and ecosystems well as consequences faced by the plants, animals, humans and ecosystem owing to the climate change. Climate change affects entire ecosystems, as well as all living organisms inside them. All living animals have had to adapt, shift, or die out as the environment has changed over Earth's history. Ecosystems and species can evolve together when these changes occur gradually. A gradual transition also allows organisms to adapt to changing conditions. When these changes happen swiftly, the species tries to adapt as soon as possible in a suitable site. Invasive species will be able to expand on new land in new ways as a result of climate change.

Keywords: Anthropogenic activities, Ecosystem, Biodiversity, Environment, Natural disaster.

INTRODUCTION

Climate change is one of the most important global environmental challenges of the present century (Prakash, 2021). The changing climate can affect the basic elements required for maintaining good health: clean air, potable water, adequate food, coastal settlement and shelter. It also increases the incidence of vector-borne diseases, decrease in crop production, more frequent extreme weather events which could be attributed to changing environment. Addressing climate change will need promoting mitigation and adaptation strategies without hampering economic development, good scientific evidence and coordinated action by multiple stakeholders. This article shows that linkages between climate change and human health are complex and multi-layered and predications of the future health impacts of climate change are still uncertain. Climate change will provide new ways for invasive species to encroach on new territory. Natural disasters like storm surges and high winds, which increase in number and severity as the earth warms, spread non-native plants and insects to new territories. Virtually all ecosystems worldwide have suffered invasion by the main taxonomic groups including India.

Biodiversity is continually transferred by a changing climate. Conditions change across the face of the planet, sometimes slowly, sometimes in larger increments leading to rearrangements of biological associations. Now, a new type of climate brought about by human activities is being added to this natural variability, threatening to accelerate the loss of biodiversity already underway due to other human stressors. The response of biodiversity to climate change has become an extremely active field of research. Predictions play an important role in alerting scientists and decision makers to potential future risks, provide a means to bolster attribution of biological changes to climate change and can support the development of proactive strategies to reduce climate change impacts on

*Corresponding author: *alkakushwaha17march@gmail.com*

biodiversity. Maintaining and restoring healthy ecosystems plays a key role in adapting to and mitigating climate change through biodiversity conservation, sustainable use and sustainable land management and yields multiple environmental, economic and social benefits.

Anthropogenic activities and Climate change: The word climate refers to the weather variation of any specific area over a period of time. Climate includes the average temperature, amount of precipitation, days of sunlight, and other variables that might be measured at any given site. However, there are also changes within the Earth's environment that can affect the climate. Climate change refers to any change in the environment due to human activities or as a result of natural processes. Climate change refers to significant and long-term changes to a region's climate. These changes can occur over a few decades, or millions of years. Climate change alters entire ecosystems along with all of the plants and animals that live there.

Climate change results due to both; natural and anthropogenic driver (Prakash and Verma, 2022). Natural Drivers involves earth's climate variability caused by changes in the solar radiations, Milankovitch cycle, volcanic eruption, plate tectonics, ocean circulations, earthquakes and so on (Kunzig, 2008). Anthropogenic Drivers involves the contribution of human activities to increasing the emission of green house gases like carbon dioxide, methane and nitrous oxide into the atmosphere at an alarming rate in different sectors such as in energy supply (25.9%), industrial sector (19.4%), deforestation (17.4%), agricultural (13.5%), transportation (13.1%), urbanization (7.9%) and waste (2.8%) (Rathore, and Jasral, 2013).

The different possible effects of climate change that can operate at individual, population, species, community, ecosystem and biome scales, notably showing that species can respond to climate change challenges by shifting their climatic niche along three non-exclusive axes: time (e.g. phenology), space (e.g. range) and self (e.g. physiology). Climate change has led to phonological shifts in flowering plants and insect pollinators, causing mismatches between plant and pollinator populations that lead to the extensions of both the plant and the pollinator with expected consequences on the structure of plant-pollinator networks (Kiers *et al.*, 2010). Climate change is able to decrease genetic diversity of populations due to directional selection and rapid migration, which could in turn affect ecosystem functioning and resilience (Botkin *et al.*, 2007).

Climate and agriculture are interrelated processes, both take place on a global scale. Global warming is projected to have significant impact on conditions of affecting agriculture, including temperature, precipitation and glacial run-off. Rising carbon dioxide levels would also have effects both detrimental and beneficial, on crop yields. The overall effect of climate change on agriculture will depend on the balance of these effects.

As the planet warms, rainfall patterns shift and extreme events such as droughts, floods and forest fires become more frequent. The densely populated coastal areas and island nations will lose their millions of homes as the sea level rises. As per World Development Report of the World Bank (2010), the poor people in Africa, Asia and elsewhere face prospects of tragic crop failures; reduced agricultural productivity; and increased hunger, malnutrition and diseases. For the Indian sub-continent, less rainfall in winter and increased precipitation in the summer monsoon are predicted; and in 2050, decreases in winter precipitation by 10-20% and by 30% for the summer have been projected **(**Kumar and Chopra, 2009**).**

Climate change and Biodiversity

The term Biodiversity is used by Rio de Janerio Convention to refer to all aspects of variability evident within the living world, including diversity within and between individuals, populations, species, communities, and ecosystems. In the simplest sense, biodiversity may be defined as the sum total of species richness, *i.e.* the number of species of plants, animals and microorganisms occurring in a given region, country, continent of the entire globe. Broadly speaking, the term biodiversity includes genetic diversity, species diversity, ecosystem diversity and habitat diversity.

Only a small change in pattern of climate has severe impact on the biodiversity, altering the habitats of the species and presenting a threat for their survival, making them vulnerable to extinction. Millennium Ecosystem Assessment (MEA) and a number of other studies predict that a changing global climate change to be the principal threatens to the biological diversity and ecosystem (Anonymous, 2007; Prakash and Srivastava, 2019; Verma, 2021). The distribution of species (biogeography) is largely determined by climate, as is the distribution of ecosystems and plant vegetation zones (biomes). Climate change may simply shift these distributions but, for a number of reasons, plants and animals may not be able to adjust resulting some species and ecosystems are likely to be eliminated by climate change. When a species becomes extinct, the species associated with it in an obligatory way also become extinct.

Beyond this, the various effects on populations are likely to modify the web of interactions at the community level. In essence, the response of some species to climate change may constitute an indirect impact on the species that depend on them. A study of 9650 interspecific systems,

including pollinators and parasites, suggested that around 6300 species could disappear following the extinction of their associated species (Koh *et al.*, 2004). A resent analysis of potential future biome distributions in tropical South America suggests that large portions of Amazonian rainforest could be replaced by tropical savannahs (Lepetz *et al*., 2009).

Due to increase in temperature several plant species like *Berberis asiatica, Taraxacum officinale, Jasminum officinale* etchave shifted towards higher altitude in Nainital. Teak dominated forests are predicted to replace the Sal trees in central India and also the conifers may be replaced by the deciduous types. According to Gates (1990) increase in 3°C temperature may leads to the forest movement of 2.50 km/ year which is ten times the rate of natural forest movement.

Anonymous (2009) reported that changes in climate affects the normal life cycle of plant and explained that invasive species are a threat to native species being more tolerant to climatic variations. The major invasive alien plant species include *Lantana camara, Eupatorium odoratum, Eupatorium adenophorum, Parthenium hysterophorus, Ageratum conyzoides, Mikania micrantha, Prosopis juliflora* and *Cytisus scoparius.* Variation in temperature and precipitation patterns can result in more frequent droughts and droughts and floods making indigenous plants more vulnerable to pests and diseases (Tibbetts, 2007).

Slight change in climatic condition leads to the extinction of animal species. For example Climate change has resulted in extinction of animals like golden toad and Monteverde harlequin frog (McCarthy, *et al.*, 2001); Polar bears are in danger due to reduction in Arctic ice cover; North Atlantic whale may become extinct, as planktons, its main food have shown decline due to climate change. Though the exact impact of climate change on India's natural resources is yet to be studied in detail, pioneering studies show that endemic mammals like the Nilgiri tahr face an increased risk of extinction (Sukumar *et al.*, 1995). Further, there are indicative reports of certain species e.g., Black-and rufous flycatcher (*Ficedula nigrorufa*) shifting their lower limits of distribution to higher reaches, and sporadic dying of patches of Shola forests with the rise in ambient surface temperatures.

The sex ratio of sea turtle disturb because as a result of high temperature more female turtles are produced. Some threatened species (frogs, toads, amphibians, tigers and elephants) are vulnerable to the impacts of climate change like sea level changes and longer drier spells. Changes in ocean temperature and acidification may lead to loss of 95% of the living corals of Australia's Great Barrier Reef (Anonymous, 2007).

Climate change also alters the disease behavior in animals. The devastating amphibian disease chytrid fungus, likely exacerbated by warmer temperatures, has left many amphibian populations dwindling or extinct. Climate changes could also have positive effects on biodiversity. For example, more increase in temperature and increased carbondioxide are likely to be beneficial to many plants, resulting in an acceleration of biomass production. Milder winters might increase survival of many currently threatened species might in temperate regions. Increased precipitation may also benefit some plant communities and species depending on them. Moreover, several studies reported detrimental effects of climate change on biological invasions (Parmesan, 2006). Although few studies report beneficial effects of global changes on biodiversity, they certainly exist and add to the difficulty of getting a clear overview of the effects of climate changes on the biodiversity of our planet. Biodiversity is affected by excessive use of pesticides too (Vinod et al., 2021). Conservation of biodiversity is big challenge in modern context (Prakash and Verma, 2019; Arya, 2021). However it is necessary for ecological balance, human survival and sustainable development (Ashok, 2017; Verma, 2018, 2019) because biodiversity loss has large impact everywhere (Ashok, 2016; Kumar and Verma, 2017).

Because of climate changes, species may no longer be adapted to the set of environmental conditions in a given region and could therefore fall outside its climatic niche. As other components of the ecological niche of species are not supposed to change directly, we hereafter refer only to climatic niches of species. To persist, individuals, populations or species must produce adaptive responses, which can be of several types, and are provided by two categories of mechanisms.

Besides climate change, invasive species also affect the biodiversity. When you combine these two, the consequences are expected to be far-reaching. Invasive species will be able to expand on new land in new ways as a result of climate change. Natural disasters such as storm surges and high winds, which are becoming more common and severe as the world heats, spread non-native plants and insects to new areas. Cactus moths, for example, were likely brought to Mexico by the winds of the 2005 hurricane season, posing a threat to unique cactus species. Almost all ecosystems in the world, including India, have been invaded by the major taxonomic groups. *Lantana camara, Eupatorium odoratum, Eupatorium adenophorum, Parthenium hysterophorus, Ageratum conyzoides, Mikania micrantha, Prosopis juliflora, and Cytisus scoparius* are among the most common invasive alien plant species.

Climate change and Ecosystem

Millennium Ecosystem Assessment (MEA) assessed the consequences of ecosystem change for human well-being from 2001 to 2005, the MEA involved more than 1360 experts to work worldwide and predicts that only a small change in climate has severe impact on the ecosystems. The Millennium Ecosystem Assessment completed in 2005 found that overall people have made greater changes to ecosystems in the last half of the 20th century than at any time in human history.

Terrestrial ecosystem: Beyond 2050, terrestrial ecosystems, which play an important role as carbon sinks, may reach the upper limit of the absorptive capacity or even, decrease their net carbon uptake. It increases the global average temperature exceed 1.5-2.5^{0}C that adversely affected the food and water supply to species. Thus, major changes in ecosystem structure & function, species' ecological interaction and geographic ranges decrease the 20-30% plant and animal species.

Marine and Coastal ecosystem: Climate change is leading to sea level rise, increased coastal erosion, flooding, higher storm surges, sea salinity ingress, increased sea-surface temperatures, ocean acidification and coral bleaching. Rising sea level presents extreme threat to marine ecosystems which can lead to disturbance in habitat and patterns of survival of marine species. Wetlands and coastal ecosystems are at a huge risk due to increasing sea levels. Many communities have already become climate refugees to evade rising sea level (Anonymous, 2007). The sea level rise recorded over the past 40 years is responsible for the loss of 28 percent of the mangrove ecosystem. Modelling suggests that up to 96 percent of suitable tiger habitat in the Sundarbans could be lost in the next 50–90 years (Loucks *et al*., 2010). Islands are also rich in biodiversity and have high economic importance. But at present due to climate change more than 23% island species are becoming endangered and hence economic loss in the tourism sector.

Himalayan ecosystem: Temperatures in the Himalayan ecosystem are increasing at a rate of 0.9 °C annually, which is considerably higher than the global average of 0.7 °C per decade. Due to this changes mosquito are seeing first time in Lhasa and Tibet cities, located 3490 meters above sea level. There are similar reports of flies at Mount Everest base camp in Nepal. The presence of these insects suggests the possible spread of vector borne diseases, such as malaria and dengue fever, to areas where cooler temperatures previously protected people from these threats (FAO, 2012).

Inland water ecosystem: It includes fresh water lotic and lentic ecosystem and comprising 0.8% of the earth's surface, but support 6% of the total species. They are rich source of food, income, employment and biodiversity. Changing climatic conditions like rainfall and temperature lead to changes in the phenology, physiology and migration trends of some organisms like migratory fishes and birds.

Forest ecosystem: One third of earth's surface is covered by forest and it is the home place of two third of all terrestrial species. They are also rich biodiversity hotspots. But half of the original forest has been cleared up till now. Green house effect has led to increase in growth of some forest, migration of tree species towards high altitude, increased attack of pest, invasive species and wild fires, hence modifying the composition of forest. According to FAO (2000), due to these changes many animals, primates and 9% of all known plant species are at verge of extension.

CONCLUSION

Anthropogenic activities are directly and indirectly responsible for climate change which has an adverse impact on the biodiversity like change in their distribution pattern, migration of species, invasion of invasive species, change in the phonological behaviour like breeding period, migration time etc, increase in the forest fires and pest attacks (Rathore and Jasrai, 2013). The timing of species life cycle events is expected to be altered, species distributions will change radically, trophic networks will be affected and ecosystem functioning may be severely impaired, leading in the worst cases to countless species extensions.

Increasing our understanding of the effects of climate change on biodiversity, and developing ways of mitigating such effects, are critical to limit such damage. Over the past decades, some of this understanding has been effectively translated into mathematical models that can be used to forecast climate change impacts on species distributions, abundance and extensions. These models are characterized by their high diversity of understanding structures and assumptions, with predictions differing greatly depending on the models used and species studied. Most of these models indicate alarming consequences for biodiversity with worst-case scenarios leading to extension rates that would qualify as the sixth mass extension in the history of earth (Barnosky *et al.*, 2011).

Thus, there is a growing realization among decision-makers that biodiversity is not an optional bonus in human affairs, but the very foundation of our existence. Moreover, biodiversity conservation tailored to changing climatic conditions is not only necessary to help species and habitats to adapt to change, but such action is also likely to mitigate climate change (FAO, 2012). In terms of agriculture, there is a need for climate resilient farming systems. Climate literacy should be spread and a cadre of Community

Climate Risk Managers should be formed in villages. The calamity of climate change should be converted into an opportunity for developing and spreading climate resilient farming techniques and systems (Swaminathan and Keshvan, 2012). It is also crucial to improve our understanding of the vulnerability of biodiversity to climate change, to develop other predictive approaches and to go beyond prediction. Even so biodiversity is a key resource in climate mitigation and adaptation strategies through the delivery of direct and indirect ecosystem services.

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International Journal on Environmental Sciences

International Journal on Environmental Sciences 13(1), January-June 2022, pp. 49-56
ISSN No.: 0976-4534

ASSESSMENT OF ANALYTICAL STUDY FOR HEAVY METALS IN TEXTILE EFFLUENTS

Rakshanda M. Ingale and Sanjaykumar R. Thorat

School of Environmental and Earth Sciences
Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon, Maharashtra

Research Article

Received: **18.05.2022** Accepted: **28.05.2022** Published: **07.06.2022**

ABSTRACT

In the present investigation, the study was undertaken to evaluate the features of textile effluent *i.e.* most of the physico-chemical characteristics and heavy metals were investigated. The results show that, higher levels of pollutants emitted into the environment than of the allowable standard. Assessed characteristic values are negatively differed but metal concentrations except sodium are positively diverted from standard limits of wastewater discharge set by BIS. In view of those characteristics, the textile industry effluents should be treated by setting eco-friendly effluent treatment plant (ETP) before directly discharging into the water bodies of textile industries to curtail pollution load.

Keywords: Analysis, Industrial Pollution, Wastewater, Textile Industries.

INTRODUCTION

The word "textile" comes from the Latin word "texere," which means "to weave." This refers to weaving, whether by hand and by machine. Animal and plant natural fibres are used as sources. One of the achievements, because of the developments, is the production of fibres utilising chemicals (Norshila Abu Bakar et al., 2020). These industries are differentiated using fibres, which are obtained from plants such as hemp, cotton, lycell, rayon, linen, and other sources. Animals provide protein fibres such as wool, silk, cashmere, and angora. Nylon and polyester, for example, are artificially synthesised fibres (Parshetti, et al., 2006). Because dyeing and wet procedures are used in the production process, and these processes are followed by sub processes like yarn and tread formation, this has an impact.

History of textile industry in India: The evidence of ancient and medieval sculpture and literature has indicated textile industry in the Harappa civilization. In Vedic culture as well, the references to weaving and spinning have been mentioned. Textiles were traded throughout the early ages. India was generating around 25% of its output in 1750, and a big export of textiles to European and Asian countries was a vital source of revenue. The largest manufacturing industry during the Mughal was cotton textiles in the 16th to 18th centuries, about 95% of which were British from Asia. And eventually, through technical and marketing advances due to colonization, has replaced traditional methods.

Recent developments of textile industry: India is having a linkage with its culture, traditions and agriculture for spread of products for domestic and for economic export. The textile is one of the largest industries in world; total export in 2017-18 was about 12.4% with 5% share in global trade in textile and apparel. Having a largest strength and manufacturing capacity across India. Traditional sector is with handloom, handicraft and small-scale power-loom units and the mill sector having about 3400 mills with

*Corresponding author: *rmingale01@gmail.com*

installing capacity of 49 million spindles and 841000 rotors. This is providing largest source of employment for millions of people. The industry is contributing about,2% GDP of India with 7% of output in value terms and 15% of export earnings and directly employing about 46 million of people. [annual report of ministry of textile2017-18].The government of India liberalized its investment policy for the textile industry for the economic reform. the Government of India uneiled its National Textile policy 2000. This policy is encouraging Indian textiles to set large integrated industries of textile and to have a joint venture with firm at international textile centres. The goal to reach at U.S $230 billion by 2020.In Maharashtra about 3,828 thousand hectares area is under the cultivation for cotton and it worth of Rs. 17,170 cr. from 1991 to 2016, covering about 958 projects under sector of textile. Major 11 textile hubs are in Maharashtra, fixed capital of USD 2,418 million with 7999 employments. (Report of Maharashtra textile ecosystem).The textile industry is playing a considerable role in the developing countries economy and this sector is one of the start-up for industrialization process, as the speedup of industrialization with population of the world and parallel reduction of water resource as the production is responsible for about 20% of global water pollution from dyeing and finishing products and 10% of global carbon emission, the increase of environmental problem, the related laws made necessary to develop and use the environment friendly sources and reduce the pollution.

Environmental impacts by textile sector: The effluent releasing varies hazardous components according to the types of chemicals used and manufacturing process in the industry. It consists of huge amount of substances such as sulphur, vat dye, nitrates, chromium, naphthol, acetic acids, and heavy meals like lead, arsenic, cadmium, cobalt, nickel, copper which cause damage to water. The presence of colour causes wastewater to become turbid (Parshetti et. al., 2011). The manufacturing process like desizing which causes high BOD, bleaching causes alkaline nature of effluent due to use of chemicals such as hypochlorite, chlorine, caustic soda, hydrogen peroxide, acids, which consumes about 38% of water (Bledzki et al., 1999), Mercerizing process releases caustic soda, dyeing process release dye stuff, reducing agents acetic acid, sulphide like pollutants, Printing process causes dye, acids, metallic salts, which utilised about 8% of water. It results high amount of water from these processes this interferes with oxygen transfer mechanism causing effect on process of self-purification process of water, and as this effluent enriched with textile waste caused soil pores blocking causes loss of productivity. (Chandra et. al., 2009). Problem of the colour in aquatic life is affecting the availability of the light to aquatic flora. (Mansour et. al., 2007) as presence of acidic and basic compounds are degrading the quality. Higher the concentration of the salts affects the soil as it makes soil not to be used for the agricultural activity. The organic compounds result to decreasing of dissolved oxygen (Saxena et. al., 2017). Metals one of the necessary element of dyes for imparting colour the release of such heavy metals(copper, zinc, chromium, lead, cobalt, manganese) causes damage to environment and human health (Hameed and El-Khaiary, 2008; Pang and Abdullah, 2013). As the first destination of the waste leftover by any industry is the environment as it over ten decades for the industrial revolution in textile sector so that to realization the pollution by textile wastes shows a significant effect on environmental health of flora and the general health of the resident of the area or the peoples these actives should lead for legal prohibition to treat hazardous waste from industry.

The Discharge is causing contamination of the water bodies, which shows reduction in the oxygen level of water and the quality of the water body there is the considerable increase from the last decade due to the increase of apparel market, which is driven by the fashion loving peoples and young generation which is leading to the consumption of the excessive use of dye for beautiful colour to fashion. This is causing numerous uses of hazardous chemicals and other substances to release directly in the environment. Approximately it has been estimated as these industries are generating over million cubic meters of wastewater. The parameter set according to release of effluent is not followed by the industries. For removal of such impurity generating from the textile industry many physico-chemical integrated treatments are present which are showing effective removal dyes but at pilot scale Shakiba Samsami (2020)each technology is showing many advantages but there are many of the drawbacks with technological used is having its limitation. Many technologies are cost efficient has been shown effectively simple, reliable at lab scale or at pilot scale: though they are not implemented at industrial scale Compulsion of the treatment process should be made and then only releasing of effluent with standard limit should be mandatory to prevent these hazards, as the requirement of the water by machine used for dyeing should made as to consume less water. As the dyes which are easy to degrade can be used this causes no trouble to environment. One of the most important and easy technique is reusing the water.

IMPACT OF YARN FORMATION

Ginning Industry: the process of separation of fibres from the seed leads to generation of cotton dust and machine noise are 89 to 106dB (Khatik, Shinde & Thakare, 2013). The workers are exposed to high cotton dust which leads to respiratory and occupational lungs hazards (Dube, Ingale & Ingle, 2012)with the heavy noise of machine which causes hearing loss (Bedi, 2006).

Spinning Industry: the formation of yarn from the raw material using heavy machinery with the high noise which shows impacts on workers as hearing loss, (Dube et al.,2012;

Weaving industry: process of fibre formation one of the nosiest process due to the heavy machines for weaving and the dust causing nasopharyngeal cancer, cough, bronchial asthma. (Anjum, 2009)

Remedies for ginning, spinning and weaving: as humidity the working areas which will help to control the cotton dust. And should encourage the workers to use the safety devices, updating of the machines should be done properly. (Hasanuzzaman, et. al., 2016).

The following are some of the effluent protection standards:

IS:2490-(BIS,1981)

Tolerance limit for effluents discharged into inland surface water: Part I of the schedule outlines general discharge effluent limitations to receiving bodies. (Indian Ministry of Environment, Forest and Environment Change, Environmental Protection Rules,1986). Schedule VI of this legislation contains information on the discharge of pollutants into the environment. I have also included dye and cotton textile industries in the programme. Effluent discharge to receiving bodies is also covered by Schedule I.

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IMPACT OF YARN FORMATION

GOVERNMENT INITIATIVES

Development and automation of Indian textile industry makes it competitive in global market but has detrimental effect on environment and human life. Automation and modernization increased the speed of production that results in consuming more and more resources and consequently pollutes the environment. Such as fibre production leads to emission of gases those are accused of global warming (viz. CO_2 and NO_2) as well as acid rain (SO_2 and NOx). While chemical processing of textile produces toxic effluent along with gaseous emissions that pollute land, water, air and leads to severe health hazards. On the other hand, mechanical processing of textile forces the worker to work in the noisiest environment that remains full of dirt and dust makes the workers to suffer from several diseases (viz. hearing and respiratory impairment, occupational lungs disorder etc). Although the effect of textile mechanical processing is limited to the work room, fibre formation and chemical processing has vast negative impact on outside world that pollutes land, water, air and emits hazardous by-product which indirectly promotes acid rain and global warming. As Indian textile industry are still using the old technologies in this developed era, machineries and its instruments are still outdated. Several schemes are allotted by government of India such as National textile policy (NTP) 2000, which accomplish. To enable the textile sector to achieve and maintain a

preeminent global position in manufacturing by the year 2000 and garment exports, as well as a technology upgradation fund scheme to help with the installation of cutting-edge technology.

Chemical processing of textile industry:

1. **Preparatory operation:** the fabric is prepared for further process their impurities are removed as these impurities makes the fabric hydrophobic in nature. These are the impurities which are removed by:

   Singeing: is burning of fibre from both sides as removal of impurity is done.

   Desizing: starch from the fabric is removed, souring: oil, wax, residual are removed by chemical treatment.

   Bleaching: this is used to make the fibre perfect white.

   Mercerizing: the concentrated and cold solution of sodium hydroxide is to remove impurity. These all depends on the type of fibre and the constituent of fabric.

2. **Textile Dyeing:**

   Vat Dyes: these dyes are water insoluble, so they are converted to water soluble with caustic soda and sodium hydro sulphite than these are applied on the fabric, these are widely used for cellulose, protein and nylon fibres, these produces deep shades.

   Azoic/Napthol Dyes: these dyes are the insoluble dyes used for cellulose fibres, as they are formed by reacting the fibre with amine with naphthol's, this class is known as Azo dyes. This class give black shade to the fibre.

   Direct Dyes: these are used for the cellulose fibre as they are derived from Benzedrine salts. These are water soluble and least expensive, so there is not any use of fixing agent for direct dyes.

   Sulfur dyes: applied by exhaust dyeing method and is the water insoluble and cannot be used directly, dyes and are derived from formulating sulphur containing compounds, and are used by reducing them to sodium sulphite and sodium hydroxide.

   Reactive Dyes: these are anionic in nature. And is water soluble which react with the fibre and form covalent bond with the fibre, they react with cellulose in presence of sodium carbonate.

   Disperse Dyes: used to dye nylon, polyester material, these dyes are non-ionic aromatic compounds and water insoluble.

   Basic Dyes: these dyes are water soluble contains cationic group used to dye acrylic material, used for wools and silk and nylon.

   Acid dyes: these dyes are water soluble and are in the form of sodium salt of sulphonic acid which is having good kinship to dye wools and silk fibres.

   The source of hazards are from the discharge coming out from such process of chemical dyeing as described above; these chemical which are unfix are in effluent which are discharged with huge amount of water, as these are directly or indirectly transferred to river where water pollution is taking place as well as causing the air pollution in the surrounding as during drying the effluent is evaporating (Rathore,2012) the constituent which are to the air of through effluent like ammonia, sulphides (EPA,2001), the bleaching agent sodium hypochlorite which is causing emission of chlorine gas. (Das, 2000).

3. **Remedies:** as before releasing the effluent in the environment it must be neutralized by various method as the pollution indicating physic chemical parameters such as pH, colour COD, BOD, TDS, SS and heavy metals. (Patel, et al. 2013; Imtiazuddin, et al., 2012;)

MATERIAL AND METHODS

The sample is collected manually from inlet and outlet of textile effluent treatment plant. Sample collection was done in sterilized bottle using grab sampling technique as the sampling is done with complete care as to avoid the contamination and labelled as inlet and outlet. The effluents samples were collected in cleaned poly-propylene bottles pre-washed with 20% HNO_3 acid and rinsed repeatedly with deionized water from the effluent outlets just before the treatment plant for individual textile and dying industries for metals examination,65% concentrated ultra-pure HNO_3 acid was added to each sample by dropper after immediately collection of effluent samples to bring the pH blow 2 to minimize precipitation and adsorption onto container walls (APHA, 1998). 100 ml well-mixed and acid-preserved sample was transferred into clean beaker and 5 ml 65%concentrated HNO_3 acid was added and covered with a clean watch glass. The beaker was heated (120-150º C) slowly on a sand bath hotplate in a fume chamber and evaporating until the sample is reduced to about 10 ml. The suspension was kept for cooling at room temperature and later added 5 ml 65% concentrated HNO_3 acid and 10 ml 70% concentrated $HClO_4$ acid. Suspensions were heated gently at 200˚C and melt away to about 10 ml. After cooling at room temperature, the suspensions were diluted to 100 ml in a100 ml volumetric flask with deionized water. Then the

solution was filtered using Whatman No. 41 into plastic bottle and kept the solution in the refrigerator until analysis. The digested effluent samples were analysed by Flame Atomic Absorption Spectrophotometer (Model: AA-6800,Shimadzu) to determine calcium (Ca),magnesium (Mg), copper (Cu), zinc (Zn),nickel (Ni), lead (Pb) and cadmium (Cd). Sodium (Na) was determined by FlamePhotometer (Model: PFP7, Jenway). Throughout the whole process of sample preparation and analysis, special care was taken to minimize impurities from air, glassware and reagents. All glassware were washed with deionized water before using in this study. All reagents used during analysis were prepared from analytical reagentor higher-grade chemicals. All instruments were calibrated with standard solutions in accordance. Ghaly et al., 2014; Kale, 2016; Malik and Abdul 2013, Parshetti, et al. 2006; Patell and Vashi, 2015; Rathore, 2012 and Thorat, 2002.

RESULT AND DISCUSSION

As per the result the parameter is showing the need to be treated before discharge. As the Primary process is not able to remove the impurity so complete tertiary treatment is required.

Temperature: as per the standard limit according to BIS is about 40degree Celsius and as per the effluent collected have shown 48 mg/l for inlet and 46 mg/l outlet as to treat effluent with chemical and biological technology the temperature must be controlled as per requirement as the rise of temperature results crop growth reduction with decrease of dissolved oxygen (Gaikwad et al., 2014 Thorat and Chavan, 2004).

Electrical Conductivity: it is measured though conductivity meter as per BIS Standards it should be 1400µS/cm. Though it is used to measure the salinity of effluent, it depends on mobility of ions, temperature. Higher the conductivity rates the life forms is affected by dehydration.

pH: the pH is measured by pH meter, as the BIS standard limit for pH is 5.5 - 9.0. and the effluent has shown as 7.5-8.6, this observed reading showed alkaline affinity, due to presence of heavy metals with increased pH as shown in Table no. 1 which determines the nutrient availability with its solubility, so it is a significant one for treatment.

Colour: Due to presence of colour to the effluent it alters the photosynthesis activity due to colouration is dark it is affecting other parameters likewise temperature DO and BOD. etc. dyes, colour producing compound and metals presence is showing colour to the effluent as shown in Table no. 1. (Malik et. al, 2013)

Turbidity: the observed value for sample is19 NTU for inlet and 16 NTU outlet, the standard for as it affects the aquatic life as it does not allow the sunlight to penetrate due to suspended impurities are present in the effluent which causes decoration of water.

Dissolved oxygen: According to Standard limit is dissolved oxygen is evaluated by wrinkle's method which resulted nil for inlet and 0.5 mg/l outlet as the increase in oxygen level leads to overgrowth of bacteria and other microbes, as if untreated effluent dumped in the water which reduces the dissolved oxygen rate of water bodies as shown in Table no. 1.

Biological oxygen demand: this shows the oxygen utilized by the microorganisms, as the BOD is higher so it can be said as water contains more decomposable substances results higher amount of oxygen demand. Sample BOD observation is910mg/l inlet and 368mg/l outlet and according to standard of BIS is 100mg/l. as higher the observed value showed higher polluted effluent as shown in Table no. 1.

Chemical oxygen demand: it calculates the non-biodegradable organic load present in the effluent according to BIS standard it should be 250mg/l. higher the concentration of COD it shows more hazardous effects on the aquatic life (Varma and Sharma, 2011).It caused depletion of dissolved oxygen on the surface of water rapidly. As increasing COD level as compared to BOD also indicates significant level of toxic and due to impurities of heavy metals in effluent as shown in Table no. 1. (Ingale and Thorat 2021).

Total Suspended solids and Total Dissolved Solids: It is the estimation of organic and inorganic constituents present in the water. as the TSS and TDS are higher due to the dyes present in the effluent of textile as it reduces the clearness of water as it reduces the sunlight penetration which reduces the dissolved oxygen as the temperature also increases due to the suspended particles which trap the sun rays and heat the water. (Kawser 2011) the prescribed limit of BIS for Total dissolved Solids are 2100 mg/l, and the Total suspended Solids limit is 100mg/l as shown in Table no. 1

Chlorides (Cl): during the process of bleaching, washing of fibres and use of chemical like hypo-choric acid, hydrochloric acid and in disinfection process and it is also used as the fixing agent for dye as it is causing the increase of chlorides in wastewater as it shows effect on growth of plants is reduced, it influence conductivity, TSS, TDS and alkalinity and indirectly they are added to the environment and disturbs the food chain and as these chlorides are used as disinfectant as they kill the microbes easily as shown in Table no. 1. (Varma and Sharma, 2011).

Heavy Metals: these are present in the dying agents as they are used during the process of finishing as an oxidizing

agent. (Ingale and Thorat (2021). Some are used as the micronutrients in plants as zinc, copper and nickle but the excessive presence of the metals caused toxicity. Metals arise from metal complex dyes, dye stripping agents, oxidizing agents and finishers in textile effluents (Gaikwad S.R. Thorat S. R. and T.P. Chavan 2004). Pb and Cd concentrations were found below finding limits in this investigation. The range of Cuintensity was assessed from 0.012 to0.02 mg/L with a mean of 0.016 mg/l. Cu is an essential substance to human sustenance as a component of metallo-enzymes in which it acts as an electron donor or acceptor. However, in high concentrations, it can cause anaemia, liver and kidney damage, stomach and intentional irritation(Thorat and Wagh, 2000). Cu is toxic to aquatic plants at concentrations below 1mg/l, whereas a concentration close to this level can be toxic to some fish. The exact Zn concentration was observed in the range of 0.091 to 0.141 mg/l. Zn concentration in effluent improves due to use of chemicals impurities and process of viscous rayon fibres in textile industries. High concentration of Zn in water is extremely dangerous to aquatic life throughout early life stages. Ni concentration in textile effluent experiments varied from 0.006 to 0.009 mg/l. The most destructive health impacts from disclosure to Ni contain lung fibrosis, cardiovascular and kidney diseases and cancer of the respiratory tract. The evaluated concentrations of Cu, Zn and Ni are lower than the permissible limit of wastewater discharge specifications according to BIS standards as shown in Table no. 2. The mean applications of Cu and Zn in textile effluents in the present examination were lower than stated by Ingle et al. 2005, Thorat 2002, Sayed et al., 2006 in Maharashtra Ni= 0.67 mg/l.

Table 1: Physico Chemical and Heavy Metals Characterization of Textile Industrial Effluent.

Sr. No.	Parameters Characteristics	Sample	Methodology	Inlet values	Outlet Values	BIS limit
1	Physical	pH	pH Meter	8.4	7.6	5.5-9.0
		Colour (ADMI)	Appearance	Light purple	Dark yellow	
		Temperature	Thermometer	48	46	>40
		Electrical Conductivity	Conductivity meter	3085	2837	1400
2	Chemical	Turbidity (NTU)	Nephelometer	19	16	
		Alkalinity	Titration	2330	1065	
		Chloride	Titration	7040	2230	600
		Total Suspended Solids	TSS dried at 103-105ºC	125/	50	100
		Total Dissolved Solids (mg/l)	TDS dried at 180ºC	9220	8330	2100
		Chloride	Standard Titration Method	626	756	600
		Sulphate	UV spectrophoto-meter	2380	1940	
		Nitrate	UV/Visible spectrophoto-meter		138	0.1
3	Organic	Dissolved Oxygen		Nil	0.5	
		Chemical Oxygen Demand	Standard Method	3788	836	250
		Biological Oxygen Demand	BOD5 Track Method	910	368	100

Table 2: Assessment of Heavy Metals Characterization in Textile Effluent.

Sr. No.	Characteristics	Metal Value
1.	Na (mg/l)	4,659.890±230.902
2.	Zn (mg/l)	0.141±0.0066
3.	Ni (mg/l)	0.006±0.0015
4.	Pb (mg/l)	BDL
5.	Cu (mg/l)	0.012±0.0002
6.	Cd (mg/l)	BDL

BDL-Below detection limit

CONCLUSION

In terms of pH, hardness, electrical conductivity, biochemical oxygen demand, chemical oxygen demand, and heavy metals, wastewaters show significant deviations from BIS requirements. The highly polluted effluents have an adverse effect on water quality, resulting in substantial environmental and health issues. Our research reveals that the quantified Physico-chemical parameters such as temperature, colour, pH, dissolved oxygen, electrical conductivity, biological oxygen demand, chemical oxygen demand, total solids, total alkalinity, total hardness and Na were found higher than the standard recommendations. Pb and Cd concentrations were found below detection limit, but calcium, magnisium, zinc, nikel and copper concentrations were measured lower than the standard procedures. It is recommended that the effluents of textile industries must be treated well by treatment processes prior to their disposal into the adjacent water bodies to decrease the pollution load and avoid harmful pollution impact. The use of detergents (octylphenol ethoxylates, alkyl phenol ethoxylates and octylphenol), softeners, addition throughout souring and desizing and the residual dye is also the contributing to larger increase in intensity of chemical oxygen demand.

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