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PSYCHO-SOCIAL IMPACT OF NATURE IN MARGARET ATWOOD'S SELECT NOVELS

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ABSTRACT

Margaret Atwood is one of the most talented, powerful and intelligent writers in the west today. She articulates the dilemmas, contradictions and ambiguities of the late twentieth century with all its complexities and extremities. Casting her vision of life in myriad forms her techniques and themes know no limit. Known widely as a poet and a novelist, Atwood is also a critic, a short story writer, an essayist, a caricaturist and a writer of children's books. A versatile genius, Atwood through her novel explores the various inter-related social, physical and psychological anxieties of the people. Portrayal of women characters in literature are as varied as the authors who create them. Female protagonists have represented an interminable array of roles throughout literature. Whether women are represented as angels or metaphorical monsters, it is obvious that female characters have been pigeonholed and stereo typed for centuries.

Keywords: Psychological Approach, Canadian fiction, Margaret Atwood, nature.

Margaret Atwood is one of the most talented, powerful and intelligent writers in the west today. She articulates the dilemmas, contradictions and ambiguities of the late twentieth century with all its complexities and extremities. Casting her vision of life in myriad forms her techniques and themes know no limit. Known widely as a poet and a novelist, Atwood is also a critic, a short story writer, an essayist, a caricaturist and a writer of childrens books. A versatile genius, Atwood through her novel explores the various inter-related social, physical and psychological anxieties of the people.

In the portrayal of the quest of the protagonist, the concerns of Atwood regarding various humanitarian issues could be seen. Of course, she is not an exception in voicing such concerns. Writers of every age and every background have been and are engaged setting right the unfair tendencies that are prevalent in the society. All the writers strive to express their thoughts various modes. Therefore, it could be asserted that all those writers have had humanitarian concerns with different viewpoints. Atwood is only a part of this mega frame work. Still she is regarded as an outstanding and distinct writer because appreciably Atwood is a well-poised writer.

Atwoods novels show how daily life gradually wears women down. The little battles won or lost reduce the resilience of women. Urban decay plays an important role in *Cat's Eye* where a contrast between Toronto and northern bush is brought out. Most protagonists suffer because of the distorted attitude of the Urbanites. Mothers are compulsive, fathers are feared, and children are sadistic. Urban decay is an inescapable part of urban life. Urban living and its decay lead to physical and psychological violence against women. The housewives in *Cat's Eye* should love out their marriages where divorce is possible but frowned upon leading to impoverishment. The protagonist in *Cat's Eye* reflects on her childhood in Toronto that is not pleasant. She had difficulties in learning to socialize with other children who were not vulnerable as her. By learning to deal with her childhood, the protagonist learns to enjoy the present. She accepts the bad things that have happened to her and accepts bad things she has done to others. Understanding of these actions helps her to reject victimization. Atwood shows the rejection of victimization by breaking away from the society.

Her four protagonists survive because they are able to change and transform in order to fit in to their environments. These metamorphoses allow the women to find a language suitable for them, thus enabling them to rediscover their voice. They "survive" in a specific way. To be deemed a "survivor" one must not simply continue living, as might be the accepted definition for the term. In fact, Atwoods women survive on many different levels. As Atwood describes in her thematic guide to Canadian literature, Survival in order to Survive from being victimized, one must become a "Creative non-victim" (Scion 38). This position is for „Those who have been able to move into it from internal causes of victimization have been removed". They each thwart off a sort of metaphoric death of women in focusing all to reach this position. They each thwart off a sort

of metaphoric death of self to re-emerge as stronger, more connected selves.

Atwoods fascination with mortality is prevalent in all of her novels. She admits to this enthrallment in her chapter titled" Negotiations with the Dead" from her work by the same name. She states "All writing is motivated, deep down, by a bear of and a fascination with mortality....to bring something or someone back from the dead" (NWD 156). Atwoods entire protagonists in a sense undergo this journey to the underworld. Theyembark on their own negotiations with the dead. Returning from this journey is not the only way they survive, however. All four women are cruelly victimized in innumerable ways.

One of the most triumphant ways of these women survive is through finding their voice in writing, just as Atwood has. By writing, her protagonists are able to leave something behind to be remembered by; something permanent. Atwood has stated that the nature of writing is "its permanence, the fast that it survives its own performance" (NWD 158). So, just as Atwood exists through her own writing, her protagonists survive through theirs. They overcome responsibility for it. They embark on many journey and are able to reach the destiny "Position Four: To be a creative non-victim" (SF 38). The operative word being "creative" for it is only through creativity that they are able to find their voices and true survival. As Atwood has stated, "Other art forms can last but they do not survive as voice" (NWD 159). Fortunately for Atwoods protagonists, the rediscovery of their voice enables their survival.

Four prominent characters, who fit the previous descriptions, are the nameless protagonist from *Surfacing*, Elaine Risley from *Cat's Eye*, and Marian from *The Edible Woman* and Offred from *The Handmaid's Tale*. All these women are forced to struggle with varying elements in their lives. In order to survive, the womenneed to connect to their pasts and other people in the attempt to become a less divided, whole self. The heroine in *Surfacing* struggles with her inability. This event has split her reality, her memory, and her personality. Elaine Risley suffers from similar issues. She too, is tormented by her past. Her tumultuous childhood has rendered her incapable of connecting to others. Rennie Wilford also suffers from an inability to feel and connect to others. Her struggles are the result of more obvious invasions. Throughout the novel she is forced to die with a break in (a violation of her privacy) and cancer (a violation of her body). She, likes the other protagonists, caste as an inability to connect to others. Offred is stripped of her identity and is restricted from free use of language and literacy.

The Republic prohibits any sort of alliances. Therefore, Offred is unable to connect with others as well.

This inability to connect is common among Atwoods protagonists. In order for them to survive they need to overcome the impediments that make connection possible. Not only do they need to be able to connect with other people, but also they need to connect to their past and themselves. Only then can these women be considered more fully integrated selves. A nameless protagonist from *Surfacing,* Elaine Risley from *Cat's Eye,* Marian from *The Edible Woman,* and Offred from *The Handmaid's Tale* are victimized in myriad ways. They all suffer from fragmented memories of their past and have been placed in degrading positions. Each individual protagonist was victimized.

The particular way in which they survive is significant. They do not simply continue to live. They are all able to recover a lost or oppressed piece of themselves and can therefore reconnect to become whole again. These four protagonists ultimately acknowledge their own responsibility for their victimization, and that reorganization helps them find their personal once and regain a political consciousness. Through a close examination of Atwoods protagonists, it is clear that these characters succeed in procuring "knowledge of their place". By gaining possession of this knowledge and by acknowledging responsibility for their victimization these characters are able to become "whole" again. They are able to survive.

It further illuminates the victim that victimizes dichotomy; while reiterative the plethora of reasons that

Atwoods protagonist should be deemed survivors. In order to understand Atwoods female characters, it is necessary to examine certain generalities that can be seen in Atwoods works, specifically her thoughts on feminism and survival. Arguably, she is one of the most prolific Canadian writers. Her works have been thoroughly studied and examined. Atwood is impossible to pin down, although critics insist on trying to categorize her.

As Rosenberg points out, "Reviewers of Atwoods work have attempted to place her in many different categories" (Rosenberg 15), including the misnomer that Atwood is a "feminist writer" (Rosenberg 15). Although the feminist factor is clearly an important issue, "She refuses to endorse

feminist cliches because she intensely dislikes the role of the rthodox ideological mouthpiece" (Pache 126). Atwood resists being lumped into the same categories and stereotypes with what is thought of as a „typical feminist writer. Elaine Risley from *Cat's Eye* for example, is a strong female protagonist, but her emotional problems are the direct result of other women. Atwoods female characters are ambiguous, in that they all posses positive and negative qualities, which prohibit them from being categorized as all good or entirely bad.

By giving a scientific fictional background, she stresses the point that man may advance in Science and technology but that may not give him completely happy .The only thing which can sustain him is love and compassion. This is implied in the novel. Gilead has an environment whose action depend upon scientific technology that is p[possible but not as yet realized. Compucount, Compucheck, Compubank, Compuhome and Soul Scroll parade. But viewed in the light of the existence for the modern society. But viewed in the light of the proceedings of the novel, a discerning reader can decode the message of Atwood, that scientific technologywhich can be employed for mans happiness and success can equally be instrumental in destroying his relationships with the fell beings and his undisturbed relationship with God.

As Pache points out, "Atwood prefers to look at womens role in society, more specifically at the women writers role in society. She works by pinpointing inconsistencies and contradictions, keeping a keen eye on changing conventional attitudes, rather that lending her voice to an abstract critique of the system" (Plahe 126). She does this brilliantly. At no time in her novels does she voice outrage against society in general; instead, she spends time examining the minute details. She does not hold one sex culpable over the other for societys problems.

The protagonists in Atwoods novels struggle to understand why they are dissatisfied with the world around them. They do not fit easily into the society. Some go beyond recognition of victimization, others attempt rejection, and some fail but most survive. All of them use one agent that is difficult for others: their creativity. They do not have any conventional heroes or do not perform any extraordinary actions. All of them are women in typical situations who refuse to accept and do what they can to fight victimization.

Victimization and survival are the themes explored by Atwood in her criticism, fiction and poetry. As a Canadian woman writer, Atwood is concerned with the issue of victimization and survival of both Canadian experience and female experience. She sees a similarity between the status of Canada and of woman. Power political is the major and common factor in both. Atwood explores the Canadian national consciousness and the female psyche.

Atwoods strategy consists of creating female protagonists who, each in her own way, find the means to seize the metaphorical pen and conquer their fear of being chased. The protagonist from *Surfacing* uses pictures to connect to her past. Elaine Risleys pen takes the form of paintbrush, which she uses to create meaning on her blank canvas. Rennie Wilford is determined to be an important journalist and write about significant issues. Offred finds her voice and seize the ability to speak out by narrating her sordid tale. By allowing her fictional characters the ability to create, Atwood herself proves that she too has the power to seize the pen. She is not afraid of "castration".

What makes Atwoods book such a moving tale is her cleaver technique in presenting the heroine initially as a voice. She is almost like a sleep walker conceiving disjointed perception of her surroundings as well as flashing reminiscences about a by-gone life. As the scenes gather prominence, more details start to fill in The heroines voice is steadily and imperceptivity transfigured into a full-rounded one which parallels her maturing comprehension of what is happening around her. As Amin Malak observes, Thus the victim manipulated and metamorphosed into a determined conniver who angrily violates the perverted canons of Gilead. (14)

Atwood skillfully manipulates the time sequence the heroines pre-Gilead past and the present. Those shifting reminiscences offer glimpses of life filled with energy, creativity, humaneness and a sense of self-hood. This life sharply contrasts the totalitarian features such an alienation and suffering. By the end of the novel, the reader is effectively and conclusively revealed how the regimental misogynous state functions: it is rather of power, not choice, coercion not volition, of fear not desire. In other words, Atwood administers in doses the assaulting shocks to our sensibilities through a grim dystopian nightmare.

The fact that her victimized protagonists all suffer from specifically female issues has to be acknowledged as well. Many of the struggles that they are forced to deal with are strictly feminine struggles; the nameless protagonist from *Surfacing* is haunted by her abortion. Elaine Risley is tormented

by her desire to be accepted in womens society. Rennie Wilford has had a mastectomy and Offred is objectified by the mere fact that she has "viable ovaries." These women struggle because they are women. In order to survive, they need to address the inequalities of their societies and reconstruct themselves. They are thus the emerging women and they eventually are able to take greater control of their lives by resisting society's expectations for women and creating their own.

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EQUILIBRIUM OF ECOLOGY AND ENGLISH CHALLENGES FOR TOMORROW'S LEADERS: A STUDY

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ABSTRACT

The vision of the greenish world refashions lightning into brownish ground. When our human minds enlarge, our souls and hearts become brownie and narrow. Our world is expected to face massive calamities which have already given enough signs to be aware of disasters like Tsunami, earthquakes, global warming and less prime span of living. According to the poet W.H. Auden "a culture is no better than its woods". Today's children are being taught how to cut away the trees and build fine air conditioner rooms. Being an English teacher, one has the greatest responsibility in language classroom in molding the future leaders. If we do not care of our square classroom today, our circle globe will be no more for next generation. Only our four pillars of classroom are to shape our Earth. Students are facing many problems in indoor learning like attention difficulties, diminished use of sense, hyperactivity, and childhood obesity and disconnection from real things. English teacher has to have the efficiency to transfer students' ability into positive environmental action to preserve our earth as over grown living areas. It's our responsibility to grow our children with greenish perspective. This paper focuses how to develop our ecological system through English for tomorrow's leaders.

Keywords: greenish world, massive calamities, span of living, molding the future leaders, outdoor learning, positive environmental, balancing ecological system

Ecocriticism or ecological studies are known as "green cultural studies", "ecopoetics", and "environmental literary criticism". Cheryll Glotfelty describes it as the study of the relationship between literature and the physical environment. It is the human perception of nature and its consuming natural core by human beings (Glotfelty Cherill and Harold Fromm, 1996).

Einstein said, "Remove the bee from the Earth and at the same stroke you remove at least one hundred thousand plants that will not survive". If the bees disappeared off the face of the Earth, man would only have four years left to live. No more bees, no more pollination, no more plants, no more animals, and no more man (Calaprice and Alice, 1998).

Balancing our ecological system is the essential duty to all human beings. In the name of modernism, sixth sense (common sense which only human deserves it) eradicates other living organisms which are underneath of human. Still humans do not have the knowledge that surviving without these living natures are impossible in this world. Though government rules and laws and NGOs are more in number and have been doing their services and creating awareness among society about ecological imbalance and problems which faced by humans are lamented. There may no special initiative taken by academicians and corporation bodies to preserve ecology.

Ralph Waldo Emerson, "He who knows what sweets and virtues are in the ground, the waters, the plants, the heavens, and how to come at these enchantments, is the rich and royal man" (Emerson and Ralph Waldo, 1860).

God has created this world as like one has to kill others to make him/her/it alive or survive. Although we call ancient as uncivilized, he is well known about art of balancing ecological system which civilized man (modern human being) fails to understand. For the benefit of civilization, nature has been corrupted and turned into desert. Civilized men are uncivilized in ecological unbalancing.

In historical perceptive, it is said in both Indian and western epics like Mahabharata and the Bible. In Mahabharata stated that "The forest protects the tiger and the tiger protects the forest" as well as in Tolkappiyam, the division by names of lands is like Kurinji, Mullai, Marutham, Neital and Paalai (*Tolkappiyam* by Tolkappiyar). This indicates ancient people's cultivation and its importance in the preservation of nature and ecological system. The ecological studies are more importantly, for the ethical stand it takes, its commitment to the natural world as an important entity in itself rather than

simply as an object of thematic study. It focuses on natural writing, romantic poetry and canonical literature to take in film, TV, theatre, animal stories, architectures, scientific narratives and an extra ordinary range of texts, literary and non-literary.

Today ecological studies are focusing on damaging and altering hub of the natural ecosystem by human beings. Nature is destroyed by man by various factors like smugglers and poachers, human greed, atmospheric pollution, threats of global warming, population pressure and nuclear weapons. Though these disasters are very well known to all, our carelessness is still being remained. It is the duty of the educated ones to make environmental awareness as well as the importance of maintaining the ecological system among the unknown ones. As a teacher, especially English language teacher, one should be aware of these calamities and orient students on the imbalance of nature and ecosystem. English language teacher has the role of teaching not only English language but also ecological misbalancing as language is a part of the eco system.

In this modern world, there are many literary works with ecological themes like William Blake's *The Tyger,* Robert Frost's *Stopping by woods,* Raja Rao's *Kanthapura,* R.K. Narayan's *Malgudi Days* etc and the ideal example is Ruskin Bond books especially *Room on the Roof* (Krishnaswamy and Ram, 2015). Using these literary texts, English teacher can craft students with English as well as ecological studies.

Lines from the poem "The Tyger" by William Blake.

Tyger Tyger, burning bright,
In the forests of the night;
What immortal hand or eye,
Could frame thy fearful symmetry?

(Blake, William)

This is the poem about Tiger which tells Tiger's braveness and its good qualities. Mostly an English teacher narrates this poem from the author's or his own point of view or ready-made notes but many teachers fail to implement this theme into real or day to day life. Even in the higher education, only theoretical perspective on ecological issues being dealt in the classrooms but practical orientation to students on ecological issues is the need of the hours.

English language teacher should not bring the meaning of the poem alone, but he/she should have multi-talents to share additional information about the theme of the poem which is correlated to the real life to enrich the students' mentality in different perceptive, especially at ecological symmetry. In this poem "The Tyger", author describes Tiger's qualities of physical appearance of immortal eye and hand, cosmos like fiery eyes, twist sinews of the tiger's heart. Creator should have very conscious of creating horrible heart and compare him to a blacksmith who enjoys seeing of his eternal creation of beauty. The awe of the tiger as well as sheer physical aesthetic is combined beauty and horror of the tiger. In addition to that teacher can notify on the subject of tiger's scarcity and its roles in India and other countries. So many interesting facts can be included in the language class room just like the tiger can hunt during night time alone, how to preserve and destroy tigers, there are only 3890 tigers remain in this world, facts on the reproduction of tiger and human related news like Tiger as prey, man-eating tigers, commercial hunting and traditional medicine, and captivity can be discussed.

The next step of teaching is ecological vocabularies and grammatical sentences in language learning classroom. Teacher can pick the vocabularies and sentences which are related to the ecological studies and teach the meaning of the words and sentences with the help of flashcard, dictionary, green board, and projector. Students can feel and live with the nature without harming it. For example, some of the natural and sentence words in this poem which are related with nature like immortal hand or eye, fearful symmetry, distant deeps or skies, Burnt, sinews of thy heart, wings, seize the fire, heart began to beat, watered heaven, deadly terrors clasp and hammer can be taught to students. Some other activities can be conducted for students to the taking them zoo or forest visit or museum to demonstrate and experience the real life examples of nature. Present and future world is more in need of natural existence than aesthetic.

This method of teaching has more advantages but only few disadvantages. Students can understand the importance of nature, how to live with nature without harming or disturbing. It helps them to view innovative and broader perceptive of learning which facilitate to solve their day to day problems in real life and also future generation will obtain greenish environment to survive in our Earth. Sometimes, teaching ecological studies in language learning classroom pushes literature and aesthetic sense out of the text and student's imagination can be beyond the language learning. Learners can acquire more additional information than core of the text. So teacher should aware of his/her teaching to learners with effective learning of English as well as ecological imbalance.

At culminating, human beings should understand the relation with nature of living is the best part of their present and future life. In this world, each and every living and non-living being is interrelated with one another. There is a relationship with cosmic space and butterfly which functioning nook and corner of the entire organism in this world. Anyone can give awareness of preserving our natural Earth. A language teacher's support should be more and effective among future leaders of this world.

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ECOLOGICAL CONNECTIVITY IN KINGSOLVER'S PRODIGAL SUMMER

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ABSTRACT

Barbara Kingsolver has been acclaimed as an eco-friendly writer and her extensive education in biology is on display bin her book Prodigal Summer, laden with ecological concept and biological facts, weaving together three stories of human life. Each chapter in the novel *Prodigal Summer* deals with the three main characters and are named "Predators", "Moth Love", "Old Vhestnuts". In this novel the reader learns about animals, insects, forests, and the intertwining ecological system in which they coexist in the lush Appalachian Mountains or by living on a family farm in Kentucky. Even though humans are a different species than coyotes and moths and trees, feels Kingsolver, all deserve a place in the world since they depend on each other for different functions.

Keywords: Ecology, progeny, human interventions, rebirth, biological facts.

Barbara Kingsolver, born in 1955, grew up in a rural section of eastern Kentucky and began to write even as a young child. She took on a number of jobs such as copy editor, medical technician, researcher, and translator. Her experience at writing in the sciences at Arizona led her to a job writing features for magazines and newspapers, and she proved to be excellent at the work, winning an Arizona Press Club award, and an honorary Doctorate of Letters from DePauw. She began writing her own fiction during this period, usually at night. In 1985, she sat up at nights writing the book that would become *The Bean Trees*, a story about a woman who leaves her home in Kentucky for Tucson. In the next few years she published *Homeland and Other Stories,Animal Dreams, and Pigs in Heaven.* Her fourth novel, *The Poisonwood Bible*, appeared in 1998 and brought her true commercial success. The book was a bestseller for months and was an Oprah Book Club selection, guaranteeing it several hundred thousand sales. The story departed a bit from her previous work in that it focused on a missionary family in Africa and the subsequent effects of that experience on each member of the family.

Prodigal Summer appeared in October of 2000, and again won praise for the depth of its characters and the interwoven strands of three separate but related narratives. In 2002 Kingsolver published another book of essays, *Small Wonder.* A theme that seems to be developing in this book is a respect for and understanding of nature. The three main characters in this story spend much of their time studying and thinking about the nature that surrounds them. The author begins the book by giving detailed descriptions of the various flora and fauna that surround the characters during the rebirth and renewal taking place in an Appalachian mountain during spring season. Nature's call is audible throughout Kingsolver's world. In the opening pages she writes: "Here and now, spring heaved in its randy moment. Everywhere you looked, something was fighting for time, for light, the kiss of pollen, a connection of sperm and egg and another chance."(1) She then continues with the same amount of detail and analysis of the natural world throughout the rest of the seasonal cycle. The constant hum of the forest permeates every page of Barbara Kingsolver's novel, *Prodigal Summer, w*ith insects incessantly buzzing, twigs snapping, animals scurrying, leaves whispering, birds squalling, moths mating, it's as if hundreds of different languages are being spoken all at once. The forest is not a quiet place, and *Prodigal Summer* is not a quite novel.

The significance of the novel's title is the description of summer in the story is "prodigal" in related senses, which are explored in detail. The most obvious meaning is that of "wantonness or wastefulness or fecundity," and the natural world of Zebulon county certainly lives up to the definition. The summer is repeatedly described as being wet, lush, exuberant, extravagant, passionate, and alive. Life is everywhere, and new growth abounds in the woods and farms. Deanna notices this early in the season.

She needed to listen to this: prodigal summer, the season of extravagant procreation. It could wear out everything in its path with its passionate excesses, but nothing alive with wings or

a heart or a seed curled into itself in the ground could resist welcoming it back when it came (51).

It is the return of life after the winter and the continual promise of regeneration. "In all her life Lusa had never seen such an oversexed, muggy summer. Just breathing was a torrid proposition" (223)

The three women protagonists have in common their independence - ranging from Deanna's unselfconsciousness to Lusa's faltering self-sufficiency - and an intuitive regard for nature, backed up by superior education. Kingsolver, a former biologist and journalist, has a rare ability to communicate widely what she knows as a scientist, and this novel sounds warnings against hunting predators who compensate by breeding faster, or against pesticides that boost pest populations by killing off the bugs that prey on them.

The ecosystem reestablishing itself in the protected forest is seen as a common habitat, not a wilderness to be kept at bay from the farmland. This is a novel that insists on the shared animality of humans, regardless of their efforts to subdue nature. That the world is a place with its own immutable rules of hunger and satisfaction, is clear in the novel's erotic undertow amid the spring fecundity of lavishly described woodlands, and in the characters' human desires, not only for sex, but to mark their territory, for progeny, even for food; disavowing any sentimental attachment to fluffy animals, Deanna relishes meat, saying "I know a little too much about animals to try to deny what I am". She is amazed by the obvious animal facts people refused to know about their kind, such as that women exposed to enough moonlight will ovulate at full moon, or that pheremones announce their periodic fertility to men. Smells, says Lusa, who sniffs her absent husband in strange men's work clothes, are "a whole world of love we don't discuss". In a pointed irony, assiduous sperm get the better of Eddie's impressive array of prophylactics. Although insistence on human biology has been used conservatively, to limit rather than liberate women, Kingsolver's view of nature is no endorsement of the nuclear family. Not only do her women glory in single motherhood, but like the packs of sister coyotes that nurture an alpha female's young, Lusa's sisters-in-law prepare to adopt the children of a sister who has cancer.

The Southern Appalachia, where *Prodigal Summer* takes place, has the greatest terrestrial biodiversity in the world. Calculated by using a mathematical formula called the Shannon Index, diversity takes into account the number of individuals of a certain species, the number of species in the test area, the total number of all the individuals in the species, and the relative abundance of each species. Diversity is important for ecosystems because it allows more interactions between species, like more complex food webs and better soil and water quality, since each species is doing its part.

For instance, the Carolina Parakeet, now extinct, used to specialize in eating cockleburs. But since there is no longer the ‘eater’ on that food web, the cockleburs have taken over Southern Appalachia, “uneaten and would continue so for the rest of time”(247). Just increasing the number of one species would not add to diversity. The addition of only a few members of several species is better than lots of justone species. Kingsolver tries to show us the importance of biodiversity through Deanna’s love of the coyote. Though sheep farms are at risk economically if there are coyotes in the area, the biodiversity of the Appalachia may be restored through the addition of a top predator. This point is hammered into the reader over and over through Deanna’s stream of consciousness. Yet the idea that species balance is essential to a healthy ecosystem is ultimately Kingsolver’s idea, because her characters Lusa, Deanna, and Garnett work so hard to preserve species in the earth.

Each of the three main characters comes to a complicated understanding of nature that changes over the course of the book. Garnett seems to change most radically in this respect. His interactions with Nannie Rawley over the summer finally lead him to accept some of her explanations for her organic farming methods and distrust of pesticides. He initially wants the county to spray herbicide on the edges of the road near his farm, uses the poison Sevin in his fields, and believes that Nannie's refusal to do this is actually causing him harm. Her approach to nature involves working closely with natural processes, using natural remedies to farming problems, and avoiding drastic human interventions in the environment.

Prodigal Summer is a rich and compulsive read. Its acute and sensuous observation of the natural world reveals an unexpected beauty, as it traces human love in the flight of a luna moth.

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DEVELOPING ECOLOGICAL LITERACY AMONG CHILDREN

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ABSTRACT

Today mankind faces numerous problems related to physical, emotional and social aspects. One of the major causes is moving away from our mother nature. We face deforestation, climatic changes, biodiversity, environmental degradation, inequitable access to natural resources and the movement of hazardous materials in different parts of the world and many other issues. Ecological literacy is the ability to understand the natural systems that make life on earth possible. To be an ecoliterate means understanding the ecosystem and using this knowledge for creating sustainable human community. In simple terms, ecoliteracy is being aware of this beautiful, bountiful and mysterious environment. This sense of loving nature has to start from the childhood stage. The children should be reconnected to the natural environment and many activities can be designed with this view. This paper deals with the various ways of developing ecological literacy among children.

Keywords: Ecological literacy, Eco literate.

> "I speak for the trees, for the trees have no tongues…….Unless someone like you cares a whole awful lot, nothing is going to get better. It's not."
>
> - Dr.Seussthe.

Today mankind is facing numerous problems related to physical, emotional and social aspects. One of the major causes is moving away from our mother nature. In today's world human beings are running behind the money and they lack the awareness of the problem that surrounds them and the future consequences of their every action towards nature. In order to overcome the problems like ozone depletion, global warming, depletion of resources, natural disasters, climate change, etc and to manage the present situation it is necessary to make every child understand about ecoliteracy.

Ecoliteracy is the ability to understand the nature that makes life on the earth possible. To be ecoliterate means understanding the principles of organization of ecological communities and using these principles for creating sustainable human communities. Educator David Orr defines the ecologically literate person as someone with "the knowledge necessary to comprehend interrelatedness, and an attitude of care or stewardship" and additionally with "the practical competence required to act on the basis of knowledge and feeling" (92).

In today's world human beings are running behind money and they lack the awareness of the problem that surrounds them and the future consequences of their every action towards nature. One such problem is the environmental problem which includes ozone depletion, global warming, depletion of resources, natural disasters, climate change, etc. Inorder to overcome these problems and to manage the present situation it is necessary to make every child understand about ecoliteracy.

1. STEPS IN DEVELOPING ECOLITEACY IN CHILDREN

1.1. Widening the eyes on all forms of the life

It is necessary to create a view on every human being that nature belongs to all forms of life. So it is always easy to mould a child than a matured adult. Educating a child from the beginning about ecoliteracy will create a future generation in which the environmental problems will be reduced.

1.2. Hands together for Sustainability

We know that organisms do not survive in isolation; all the living things in this world are interconnected. Children should be made clear about the role of interconnectedness within their communities and they should know the value in strengthening these relationships by thinking and acting cooperatively. Projects can be given to the students that give opportunity to start building a community that values diverse perspectives towards a common good with a strong network of relationships and resiliency.

1.3. Seeing the consequences

Human beings were unaware of the consequences for their own actions. For example, if for construction purposes the forest area is cleared; it would soon cause flooding, erosion, loss of biodiversity, etc. We can make the children sense the consequences by making a field trip to an area which has been destructed but which is the source of all energies.

1.4. Nature as a Teacher

Organisms are members of systems nested within other systems, from the micro level to the macro level. Each level supports the others to sustain life. Everyone should learn from the nature to take only what they need and to adjust their behavior in times of boom (or) bust. They should also learn not to abuse the resources which they need in order to survive.

2. ACTIVITIES WHICH WOULD BE INCLUDED IN CURRICULUM TO DEVELOP ECOLITERACY AMONG CHILDREN

2.1.Celebrating nature

We should make celebrations of Earth day, Environmental day, Water day, etc. and also make the children to participate in celebrations and arouse their interest towards nature.

2.2.Enacting the nature

We could make them to enact dramas which depicts about the nature and its impact on human beings and other living things. This would make them realize about the facts related to nature and they get a closeness towards nature.

2.3. Making a Green Blanket

We can ask them to make a kitchen garden or plant tress and can make them involve in ecological activities.

2.4. Zooming in on Nature

Teach the children every aspect towards a small change in nature. Give them a book with instructions and ask them to find a rock or a tree with the instructions given. This kindles the interest among the students.

2*.5. Goggling the Earth*

We can ask them to goggle Earth and view about different landscapes and different regions and can create a love towards nature in them.

2.6. Click nature

We can ask them to prepare a photo album on the themes related to nature and could also ask them to make a collage and from this activity we could also make them appreciate the beauty of nature.

2.7. Live with nature

We can arrange camps for children in natural habitat and Make them to love nature, live with the nature and admire the nature.

2.8. Ecoposters

We would ask them to collect various seed and we can ask them to make a seed collage and form Ecoposters to make them involved in ecological activities.

2.9. Designing outdoor play

Outdoor play can help reconnect children to their surroundings and lead to a more environmentally minded generation. In addition to helping kids acquire factual knowledge, outdoor play spaces should cultivate a sense of wonder and delight and an emotional appreciation of the living world.

2.10. Allow for Direct Experience with Elements of Nature

Children can be given opportunity to interact with nature on a regular basis like working with soil which may make their hands dirty but still enjoy, they can be made to plant different saplings, grow flowers and vegetables, make compost, identify and remove weed, and more. Teachers should be encouraged to make use of the outside teaching environment as frequently as possible.

By bringing out certain changes in the curriculum by incorporating ecological activities we can develop a greener future generation and also save our mother nature.

SAVE EARTH! SAVE LIFE!

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A STUDY OF RUSKIN BOND'S "TENACITY OF MOUNTAIN WATER"

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ABSTRACT

"I am not a religious person but if I were to say I have a religion then I would say I am a nature worshipper."

Ruskin Bond

Ruskin Bond, a prolific writer, is known for his short stories, novellas and poems and is widely popular especially in Children's Literature Circles. His stories can be likened to an ecological narrative designed to spread awareness about the bitter consequences of human actions that damage the planet's basic life support system. He has received the Sahitya Akademi Award for English writing in India for 'Our Trees Still grow in Dehra' in 1992. He was awarded the Padma Shri in 1999 and Padma Bhushan in 2014. Ruskin Bond's stories breathe his great love and sincere concern for nature which is all encompassing and all pervasive.The prismatic portrayal of nature in Bond's stories enraptures the soul. He draws our sense towards the natural brilliance manifest all around us by presenting a painstakingly drawn out record of the the natural life around him. The amazingly captured landscapes with its myriad forms of life inked by Bond's imagination and his inimitable style come with a strong lesson on the need to protect and preserve nature.

My paper proposes to study Bond's short story entitled "Tenacity of Mountain Water" that explores the interlinked web of life through a simple narrative. Weaving the threads of eco consciousness through the narrative, he marvels at how a tiny rivulet of water becomes a beautiful roaring cascade nourishing and beautifying the entire landscape. The story offers the informed reader a chance to investigate the underlying ecological values and also revisit the human perception of natural resources.

Keywords: Ecocriticism, Ruskin Bond, Nature, Water.

Greg Gerrard in his book *Ecocriticism* states that Wilderness has a sacramental value. He adds that "The idea of wilderness, signifying nature in a state uncontaminated by civilisation, is the most potent construction of nature available to New World environmentalism. It is a construction mobilised to protect particular habitats and species and is seen as a place for the reinvigoration of those tired of the moral and material pollution of the city"(59). Ecocriticism strives to promote an authentic voice, a viable narrative with *nature for its own sake* as the touchstone. As ecocritics embark on a path to deliver a new set of eyes to look at the world around us, they lead us into a labyrinth of interactions and negotiations between nature, man and culture. The large scale awareness and emphasis on resolving environmental problems has resulted in placing this mode of criticism in the spotlight.

Literature cannot be an isolated narrative. It brings together the elemental and abstract facets of life assisting reflection, introspection and evolution of the human consciousness. Cheryll Glotfelty in her 'Literary Critics and the Environmental Crisis' published in *Ecoaesthetic and Ecocritical Probings,* observes that theorists have identified two basic patterns to perceive literature namely literature as mirror and literature as model (68). In the mirror approach, art imitates life and in the model approach life imitates art. Ecocritics choose literature as a model approach looking for solutions that can help in sustenance of nature and sustained development of life and habitat.

Ruskin Bond, a prolific writer, is known for his short stories, novellas and poems and is widely popular especially in Children's Literature Circles. His stories can be likened to an ecological narrative designed to spread awareness about the bitter consequences of human actions that damage the planet's basic life support system. He has received the Sahitya Akademi Award for English writing in India for 'Our Trees Still grow in Dehra' in 1992. He was awarded the Padma Shri in 1999 and Padma Bhushan in 2014.

Ruskin Bond's stories breathe his great love and sincere concern for nature which is all encompassing and all pervasive. The prismatic portrayal of nature in Bond's stories enraptures the soul. He draws our attention to the natural brilliance manifest all around us by presenting a painstakingly descriptive record of the the natural life around him. The amazingly captured landscapes with its myriad forms of life inked by Bond's imagination and his inimitable style come with a strong lesson on the need to protect and preserve nature.

Bond, a worshipper of nature explores ecosystems through elaborate descriptions of a variety of plants and animals and scenic elements of nature. His stories gently influence the readers to introspect and reexamine their relationship with nature. Bond strongly believes that the different facets of nature are not only a source of delight but also awaken us spiritually. He explores at length the captivating beauty in every aspect of nature and highlights that every component of nature has its own intrinsic value and role to play in the intricate web of the almighty's design. Bond thus responds to the beauty of a tricking rivulet with the same awe as he would admire the deepest oceans or a patch of beautiful flowers. Bond's short stories are a powerful appeal to sensitise one's approach to nature. Water fascinates Bond and one find's umpteen descriptions and celebrations of water in its myriad forms through the escapades of the narrator who is mostly a child delighting in the presence of a waterfall, a glacier, a hidden lake or rivul*et* Bond does not believe in a clinical upkeep of nature but revels in the wild mystique and freedom that is the essence of wilderness.

Water is one of the greatest gifts of nature and Bond cannot suppress his excitement at how the tiniest drop of water travels far and wide, through high and low landscapes transforming in size and nature till it reaches the ocean. Water can be likened to survival instinct as it can make its way or rather seep its way through obstacles. In the story 'Tenacity of Mountain Water', the narrator spots a patch of fresh grass and instinctively knows there has to be water underneath. To his delight he discovers a spring of clear sparkling water and exclaims: "I never cease to wonder at the tenacity of water - its ability to make its way through various strata of rock, zigzagging, backtracking, finding space, cunningly discovering faults and fissures in the mountain, and sometimes travelling underground for great distances before emerging into the open. Of course there's no stopping water. For no matter how tiny that little trickle, it has to go somewhere!" (156-157)

The narrator follows the spring and discovers a small ravine wherein the spring had grown in size bubbling with renewed energy. He also briefly sketches the ecosystems formed around the water as it makes way through the rocks into a ravine , trickling through the roof of a cave and cascading off the hill top. Beautiful crimson maidenhair, the narrator's favourite fern, a spotted fork tail, a water spider, a pair of pine martins, patch of primrosesall offer him moments of delight. The spring then becomes a rivulet slowly expanding into a small stream. It then transforms into a waterfall and as a strong river speeds down into the valley. Unable to follow further, the narrator looks over the landscape and sees the distant silver of a meandering river and knew that his river is destined to join it and the combined rivers would become one with the Ganga which in turn fertilising the alluvial plains of northern India would merge into the Bay of Bengal. (158) The narrator further observes: " And the ocean, what is it but another droplet in the universe, in the greater scheme of things.? No greater than the glistening drop of water that helped start it all…"(158).

'Tenacity of Mountain Water' explores the interlinked web of life through a simple narrative. Wilderness allows for redemption, a spiritual sojourn, a mediation with the self and a million possibilities for a new you, a new world.Weaving the threads of eco consciousness through the narrative, the story offers the informed reader a chance to investigate the underlying ecological values and also revisit the human perception of natural resources. The need of the hour is not how man is and how he can be but rather what he can do to make the world a better place. The most important function of literature today is to channelise all energies into awareness of the fact that the human is an integral part of nature. Nature is not for man's disposal and destruction of nature will soon lead to the destruction of man himself.

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THE POETS INSPIRATION-WATER-THE ELIXIR OF LIFE

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ABSTRACT

Water, the magical substance from which all life springs forth, is essential to the very existence of every life form on earth. Every time our Mother Earth showers her love to all its living beings, it's in the form of water. Water is the only difference between other planets and our mother earth. Humans have cuddled with water forever, all our life revolves around water apart from it being a vital component in our human body. The role of water in the living organism has not changed since life's first creation in salt water billions of years ago. Water is a dominant theme in many of the poetries. The elixir of life, also known as elixir of immortality and sometimes equated with the philosopher's stone, is a mythical potion that, when drunk from a certain cup at a certain time, supposedly grants the drinker eternal life or eternal youth. The elixir of life was also said to be able to create life. It's not without reason that water is called the elixir of life. It has more scientific and natural effects according to the environmental changes. Water when consumed in the right way, not only quenches thirst, but also helps your body detox. A simple day to day routine is to have a full glass of water, and just water without honey or lime or anything, the first thing in the morning, as soon as you get up. The present paper highlights water as an important source of energy in various forms, life giver, an energiser and a source of inspiration to many writers and poets.

Keywords: Water, important source of energy, inspiration to many writers and poets, mater and matrix, mother and medium, environmental balance.

Rain, Fountains, Dew, Pools, Ponds, Storm, Thunderstorm, Rivers, Streams, Lakes, Wells, Ditches, Monsoon, Hurricane are all sources of water. Water is a Theme or Metaphor in the Arts and Literature. Visual artists, poets, novelists, composers, playwrights, filmmakers and choreographers have long been inspired by the inherent beauty, movement and sound of water. The list of well-known paintings, prints, poems, novels, plays, songs, musical compositions and dances that incorporate water as a literal image, as a theme or as a metaphor is immense. Relating to the topic of creative outpourings on water, many poets came across poems that beautifully described how water has no real shape of its own and, therefore, adapts efficiently to its environment. *The Water Table* by Gross enters a somewhat crowded waterway, and one might be forgiven for doubting that there is much more that can be said. He portrays that no specialist knowledge of or interest in the Severn is required: the river is an inspiration and spiritual inhabitant of these poems, nothing more or less.

Unusually, Gross is not that interested in the metaphorical possibilities of water: this is not a book about grief or loss, nor is his river a method of chronicling social change. Gross, instead, is absorbed in what water actually is its substance, its realness. While water in literature is often a metaphor for what cannot be expressed, in life it has a miraculous physicality all its own and Gross inhabits this completely. It makes for a remarkably solid book - despite its fluid foundations. In "Pour", the falling water is "this slick and fluted glitter, slightly arcing, rebranding itself as it falls, as for tangible seconds it's a thin taut string of surface tension that my hand feels, on the handle, as a pulse, a pull, a thing inspace that lives in this world".

"Pascale's poems are as fresh as paint, and make you look all over again at Frida and her brilliant and tragic life. What the Water Gave Me by n is a triumph of creativity and criticism, of persona and impersonation, of personality and impersonality."

This is how it is at the end –
me lying in my

While the waters break,
my skin glistening with amnion,
streaks of starlight.
And the waters keep on breaking
as I reverse out of my body.

Reflections by Douglas R. Hill, a poem on lake describes the beauty of the lake due to its environment.

My favourite spot is by the lake,
With forest by the side,
'Cause in the fall with colours bright,
Its' beauty we can't hide.

Rain, lovely rain by Sagar Chand explains the beauty of rain and the colourful umbrella used by children and its beauty. As a source of water it gives the ultimate joy also.

Children come to school,
On foot, bus or train.
They all become wet,
When comes the rain.
Children open their umbrella,
Red, blue or cream.
They all shout in joy,
Rain you always come in my dream

The poem 'Tsunami' by Brandon Evano portrays the plight of the people during the devastation.

Their souls were in captivity.
So then I wondered, 'Why, oh why,
Does God not hear their desperate cry?'
Voices wane into the night,
Ne'er heard in the morning's light,
And in compassion I reached out.
Their land will heal. They will survive.
And to this end, the people strive.

Water is the Hub of Life. Water is its mater and matrix, mother and medium. Water is the most extraordinary substance! Practically all its properties are anomalous, which enabled life to use it as building material for its machinery. Life is water dancing to the tune of solid, says Albert Szent-Gyorgyi. "It is the omnipresent rush of water which gives the Este Gardens their peculiar character. From the Anio, drawn up the hillside at incalculable cost and labour, a thousand rills gush downward, terrace by terrace, channelling the stone rails of the balusters, leaping from step to step, dripping into mossy conches, flashing in spray from the horns of sea-gods and the jaws of mythical monsters, or forcing themselves in irrepressible overflow down the ivy-matted banks." says Edith Wharton.

The Earth appeared like a precious blue stone set in the blackness of outer space to astronauts for the first time. If inhabitants of other solar systems were to visit this lovely, cool, blue planet of ours, they might just call it "Aqua" rather than "Terra" because of great abundance of its most unique feature - liquid water in streams, rivers, lakes and oceans. Therefore, earth is popularly called as "blue planet". The colour blue denotes the presence of water which covers 71 per cent of our earth's surface. Since water covers 3/4th of our planet, it is readily available, yet water is one of earth's most precious resources.'A river seems a magic thing. A magic, moving, living part of the very earth itself 'says Laura Gilpin.

Tennyson makes the brook narrate its history- the history of its origin, its meandering and uneven journey through forest and hills and open spaces until it joins the 'brimming river'. The Brook originates from a source on the highlands filled with mountain forest cover, where the wild birds of coot and fern are found in plenty. Its rushing waters touch all the ferns that grow on its banks till it reaches the open valley. In its initial rushing journey, the brook passes through the slopes of thirty hills and flows beneath more than four dozen bridges. Then it touches twenty different villages before reaching a little town.

I come from haunts of coot and fern,
I make a sudden sally
And sparkle out among the fern,
To bicker down a valley.....
And out again I curve and flow
To join the brimming river,
For men may come and men may go,
But I go on forever.

Before joining the main river, the brook passes by Phillip's farm. As it comes rushing down the hills, its waters produces different musical notes as it dashes against the stony pebbles. The brook makes its presence felt when it passes through the different fields of uncultivated lands and many front lying promontory lands where the weeping willows grow. It winds about with immense power and its cool pleasant waters bring all kinds of fresh water fish to a lively activity. Each morning when the sun rises, the rays and the beams hit the waters and brightly reflect the shiny dance of the active movement of the brook on the sandy banks. When evening sets in and total darkness covers the surroundings of the countryside, the flow of the brook continues to murmur under the light of the moon and stars. The effect of the brook on the shores

in the daytime is as much as in the night. Tennyson significantly relates the brook to human life to the sad reflection that man's life is impermanent compared with the relative permanence of a river. The brook flows down along hills. Sometimes, it also glides between long and narrow hill ranges, called ridges. Thorpes refer to small villages or hamlets. Between two small towns, the brook passes several Thorpe's and a large number of bridges. The numbers used in this line such as 'thirty', 'twenty', 'half a hundred' should not be taken in the literal sense. These numbers are used to give the impression of 'several' or 'many' and to maintain the rhythm of the poem.

Robert Creeley in his poem on rain explains his mental tense being reduced due to the rain

"My sweetness is to wake in the night
after days of dry heat, hearing the rain".

Water is the formless potential out of which creation emerged. It is the ocean of unconsciousness enveloping the islands of consciousness. Water bathes us at birth and again at death, and in between it washes away sin. It is by turns the elixir of life or the renewing rain or the devastating flood says Scott Russell Sanders.A river flows from an upland source. Here the velocity of water is faster than downstream because the river's gradient is steep. Near a river's source the valley has a narrow floor and steep sides' .The middle course of the river has a wider floor and the sides of the valley are more gently sloping. The velocity is slower than the upper stage. However, the channel is wider as the amount of water flowing in it increases as other streams and rivers join it. The lower course of the river is very gentle sloping, almost flat. The channel is usually at its widest and deepest here because the amount of water flowing within the river is at its greatest. Rivers erode in four ways: Abrasion or corrosion which is, when large pieces of bed load material wear away the river banks and bed. Attrition ,when the bed load itself is eroded when sediment particles knock against the bed or each other and break, becoming more rounded and smaller, Hydraulic Action , the force of water erodes softer rock and Solution or corrosion ,when acidic water erodes rock. Floods can bring both advantages and disadvantages to an area. Floods can deposit rich, fertile alluvium on agricultural areas. Also, flood water can replenish irrigation channels. On the other hand floods can destroy food supplies, homes and transport infrastructures. The poem Waterfalls an acrostic poem by Molly is a classic creation which is set to the tune of the waterfall.

Whooshing, pushing, gushing over rocks
Attacking everything in sight
Thrashing, bashing, crushing rocks and things like that
Error, terror, hear the power
Recking, decking, pecking in and out of rocks
Faster, crashier, bashier all around the place
Arting, darting, carting all the rocks around
Looking, cooking, booking in and out like a meander
Lushing, sushing, mushing, every-where.

Three quarters of the earth's surface is covered by water. The ocean conceals billions of creatures interacting in ways that we will never fully understand. Much of the ocean is mysterious. We cruise along on boats on the ocean's surface, and sit on beaches watching the ocean's surf meet the land. One of the great things about the ocean is that we cannot build on it. It will remain a vast open space perfect for contemplation. In a poem Sea Poem, A Day At Sea by Melissa Roberson, the poet beautifies the qualities of the ocean and the sea waves as a shelter to the fishes and the sea shells. The greeting of the ocean waves over the sand is a pleasant sign expressed by the po*et*

As the ocean waves at me,
And the sand greets the sea,
The fish swim free,
And shells wash up by me.
The sand squishes suddenly,
Between my shoeless toes.
Then the tide flows over .....

The poem the Ocean by Robert Frost beautifully explains the quality of the ocean and how a poem can stir all of the senses, and the subject matter of a poem can range from being funny to being sad. The sentiments in the words by Robert Frost finds even more effective.

The shattered water made a misty din.
Great waves looked over others coming in,
And thought of doing something to the shore
That water never did to land before.

A poem can stir all of the senses, and the subject matter of a poem can range from being funny to being sad. Children love to play in water. Famous nursery rhymes have inspired the children to play that water never did to land before. Water gives the total joy and enthusiasm to the children.

Jack and Jill
Went up the hill,
To fetch a pail of water;
Jack fell down,

And broke his crown,
And Jill came tumbling after.

Rain, rain, go away,
Come again another day,
Little Johnny wants to play.
Rain, rain, go to Spain,

The rhymes till date are a source of inspiration and joy to the children for joy and play. Children love to play in rain water. Generally people love waterfalls or the cascade, beach waters, etc. Water as a source of living makes man healthier. There is an environmental balance because of water. Imbalance of water will lead to the greenhouse effect. Disproportionate density of flora and fauna leads to global warming.

The ability of water to form of sipping water after reciting Vedic mantras that is believed to have therapeutic effect on its practitioner. Chanting creates a "memory structure" in water, somewhat like homoeopathic medicine where high potencies don't have original medicine in it but the "memory structure" of the medicine persists in water. The poem given below byMeish Goldish explores the availability of water as a source of living for all the living beings. It explores how water is a source of energy to all the living beings on earth for their sustenance.

Water, water everywhere, water all around,
Water in the ocean, water in the ground.
Water in a river, water in a creek,
Water in a faucet with a drip-drip leak!
Water in a fountain, water in a lake,
Water on a flower, as day begins to break.
Water from a waterfall, rushing down from high,
Water from a dark cloud, raining from the sky.
Water boiling hot, water frozen ice,
Water in a blue lagoon, clean and clear and nice.
Water at a fire, gushing through a hose,
Water in a garden, so every flower grows.
Water for the animals swimming in the sea,
Water, water everywhere for you and for me!

Water is a renewable natural resource and public good. But the ownership right on land bestows a private character on water. However, most rivers, ponds, lakes and aquifers are common property. Therefore, water rights are not clearly defined and the right to using the resources is not protected. Hence, excluding others from using water is not possible and the results are competition, over-extraction and conflict. However, cooperation has a greater role in achieving social harmony in water allocation and increasing human welfare. "If there is magic on this planet, it is contained in water." says Loren Eisley

Living water is the elixir that facilitates creative mind. Underground water is one of the key earth resources. Unfortunately, this resource has been depleting at an alarming rate. It is a matter of great concern. Water is indispensable for not only human beings, but also for animals and environment as well. Due to increasing use of water for various domestic, commercial and agricultural purposes, water table of all over the world is going down at an alarming rate. Protecting water resources is vital for the conservation of all species which are extincting very fast. The oceans are the planet's last great living wilderness, man's only remaining frontier on Earth, and perhaps his last chance to prove himself a rational species.

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AN ECOCRITICAL APPROACH TO AMITAV GHOSH'S THE HUNGRY TIDE

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ABSTRACT

The aim of this paper to Projects the impact of ecology in literature Ecocriticism is the interdisciplinary area which includes the study literature and environment. The literary scholar analyzes the text not only for the environmental concerns but also to the treatment of ecology as the subject of nature in literature. The word ecocriticism may have been first used William Rueckart's essay which entitled "Literature and Ecology: An Experiment in Ecocriticism". *The Hungry Tides* tells the very present story of the present day adventure, identity, history and love. Ghosh here presents the nature not as the setting of picturesque beauty alone it also aprosis as hungry of human blood. The tide and its surages stand for all the devastating the aspects of nature.

Amitav Ghosh's *The Hungry Tide* set in the Sunder bans, is a sage of Indo-American marine biologist Piya Roy. She has been to the Tide country of sunder bans in Bengal with a view to studying river dolphins. Two characters Fokir, a local fisherman who helps her to locate dolphins in Garijiontda pool and Kanai Dutta, a Delhi- based business man who meets her on his way to visit his aunt Nilima come closer to Priya's heart in course at time. Nirma's human Nirmal once had a mission for helping the displaced refugee who settled on the sunder bans island of Morichjhapi. He has this commitment to work for and help the refugee as he falls in love with a refugee, Kusum, mother of inbant Fokir. The novelist inborns that Kanai visits the 'tide country' together the lost journal written by his dead uncle Nirmal. The journal is an account of the lives of the Morichjhapi Island which is later ruthlessly evicted by military troops which claims the life of Kusum. A sudden cyclone kills Fokir when he is assisting Piya on a journey on waterways. Finally Piya determines to establish a research trust in memory of Fokir and seeks help from Nilima and Kanai to translate her dream into reality.

Keywords: Adventure, Love, Identity and Symbols.

'An Eco Critical Approach to Amitav Ghosh's *The Hungry Tide'*

Ecocriticism is an intentionally broad approach that is known by a number of other designations, including "green (cultural) studies" "ecopoetics" and "environmental literary criticism" and is often informed by other fields such as ecology, sustainable design, biopolitics, environmental history, environmentalism, and social ecology, among others.

The novel *The Hungry Tide* is a masterfully conceived and admirable one. Its is highly different from other novel by Amitav Ghosh in its form. It consists of two parts, one is the Ebb: Bhata and part two is the Flood: Jowar. In part one the Ebb: Bhata consist of many chapters, titled under different names with different ideas. The title are not easily handled by Amitav Ghosh, they are the Tide country, an Invitation, Canning, the Launch, Lusibari, the Fall, S'Daniel, Snell's Window, the Trust, Fokir, the Letter, the Boat, Nirmal and Nilima, at Anchor, Kusum, Words, the Glory of Bon Bibi, Stirrings, Morichjhapi, an Epiphany, Moyna, Crabs, Travels, Garjontola,, a Disturbance, Listening, Blown Ashore, a Hunt, Dreams, and Pursued. In part two the Flood: Jowar consist of many titles they are Beginning Again, Land full, a Feast, Catching UP, Storms, Negotiation, Habits, a Sunset, Transformation, a Pilgrimage, Destiny, the Megha, Memory, Intermediates, Besieged, Words, Crimes, Leaving Lusibari, an Interruption, Alive, a Post Office on Sunday, a Killing, Interrogations, Mr Sloane, Kratie, Signs, Lights, a Search, Casualties, a Gift, Fresh Water and Salt, Horizons, Losses, Going Ashore, the Wave, the Day After, and Home: An Epilogue. Those titles which are mentioned above are entitled with names of character in the novel. The Hungry Tide tells a very no contemporary story of adventure and unlikely love, identity and history, set in one of the most fascinating regions on the earth.

Ghosh, in *The Hungry Tide* constructs nature by using interweaving legends, experience, myths and history to reveal human interaction with the non-human world. It also makes an attempt to find out his conscious engagement with the natural world that draws our attention to impending calamity of

the global environment. Eco-critical approaches make inquiries into the connections between nature and human culture and it also views at what instant the authors represent its effects. The whole of the ecosphere where energy, matter and ideas come to an interaction is the basis of eco-criticism not alone the social world. Nevertheless, the fictional works of Indian writer in English, Amitav Ghosh, can be viewed through eco-critical perspective.

The novel tells a very present day story of adventure, identity and history and love. Ghosh here presents nature not as a setting of picturesque beauty alone it also appears as hungry of human blood. The tide and its surges stand for all the devastating aspects of nature. We may spot the following expression about mangrove forest from the Bengali script that Kanai reads in the novel:

"A mangrove forest is a universe into itself…Mangrove leaves are tough and leathery, the branches gnarled and the foliage often impassable dense. Visibility is short and the air still and fetid. At no moments can human beings have any doubt of the terrain's utter hostility to their presence, of its cunning and resourcefulness, of its determination to destroy and expel them. Every year dozens of people perish in the embrace of that dense foliage, killed by tigers, snakes and crocodiles."

The above quoted passage unfolds the tremendously unreceptive approach of nature towards man. Ghosh has presented, in the section entitled "S" Daniel", a discussion between Nirmal and Kanai about "S" Daniel's efforts in bringing people to the tidal region, which was weighed down with numberless hazards and risks to their lives. It is a matter of pity that the tidal surroundings bring not only the sudden danger to the inhabitants but a constant fear-psychosis:

"Think of what it was like: think of the tigers, crocodiles and snakes that lived in the creeks and nalas that covered the islands. This was a feast for them. They killed hundreds of people." (Ibid 52)

The work is purely of both natural and human environment. The Tide country i.e Sunderbans to which the whole of the work is devoted is not only a far-flung land of intimidating physical environment but also a place of dealings among an assortment of communities—ethnic, religious, linguistic, cultural etc.

The novelist meticulously offers the nexus: the man-nature complex interactions. Like manifest threats posed by human settlement to the unique diversity of aquatic and terrestrial life in the mangrove swamps and the constant depletion of aquatic species by fishing and trawling, the human settlers too fall victim to constant erosion of dykes and embankments, the silting up of channels, the flooding by storm waters.

The author's nuanced descriptions of the moods and microenvironments of the island serve a lush backdrop for an intricate narrative that moves fluidly between past and present. The climatic ending, in which a cyclone threatens the inhabitants of the Sunderbans, underscores Nirmal's observation that "nothing escapes the maw of the tides." (Ibid 225)

Ghosh accurately orchestrates the marvels—tigers, river dolphins, crocodiles, lunar rainbows and the tides—which go against the settlers. The work is an ineradicable mark bearing a conflict between wilderness and human civilization.

The Hungry Tide is not only a work of fiction with a well-knitted story but also it is rich in its symbolical implications. While treating an endangered ecosystem in the Bay of Bengal as its setting, Ghosh pinpoints various significant things through a number of nature symbols. Even the title of the work cannot be ignored as going simply as a title since it indicates several coats of meaning. The whole of the tidal region is represented as a place where ferocious animals pursue the human beings day and night. Besides, the frequent and sudden rise in tides brings danger to its inhabitants. Hence, the title immediately leads readers to an understanding of a situation where humans share with animals as tides bear all the devastating aspects of nature.

In the novel, the incident regarding Piya's fall in the sea indicates an aesthetic experience. The expression like "the muddy brown water was rushing up to meet her face" evokes in the reader's heart the Bibhatsa rasa or the rasa of indignation. Here it must be stated that rasa for the reader is the aesthetic experience in literature. A genuine reader experiences this aesthetic feeling, when he reads truly imaginative pieces of literature. This expression or the like in the novel turns up the whole situation to an epic feeling.

The tidal surges that get rhythmic in flow with the thematic concerns of the writer seem to be suggestive of the hard-hitting human relationship in the novel. Piya's emotional attachment for Fokir and the envy of Kanai for the fisherman are patent in the following conversation between Piya and Kanai:

'…Very few people can adapt themselves to that kind of rhythm—one in a million, I'd say. That is why it was so amazing to come across someone lie Fokir.'

'Amazing? Why?'

'You saw how he spotted that dolphin there, didn't you? ', said Piya. 'It's like he's always watching the water—even without being aware of it. I have worked with many experienced fishermen before but I've never met anyone with such an incredible instinct: it's as if he can see right into the river's heart

The noisy rise in tides, the dreadful movements of the tigers, the picture of the all encircling mud in the expressions like 'a shroud closing in on her' and 'folding her in its cloudy wrappings' along with its comparison with 'the slippery walls of a placental sac' are some of the evidences emblematic implications in the novel. The silent passion prevailing between Piya and Fokir appears as a symbolic indication of the tension between the-environmental position of the Sunderbans and the needs of the human beings who seek to survive in that hostile environment.

In *"The Hungry Tide"*, the story is based on an eco-setting, an immense archipelago of islands, Sunderbans. The cyclone has snapped the fragile balance between man and nature in the delicate ecosystem of the islands. The following shimmering expression in the novel captures the very tone of this environment

"At low tide, when the embankment was riding high on the water, Lusibari (island) located like some gigantic earthen ark, floating serenely above its surroundings. Only at high tide was it evident that the interior of the island lay well below the level of the water. At such times the unsinkable ship of a few hours before took on the appearances of a flimsy saucer that could tip over at any moment."

The novelist has the absolute ingenuity to keep analogy between the imaginative pictures of the tide country situation with the ecosystem. It is really true that this dichotomy, wild life versus human suffering or destruction of the ecosystem versus human survival could not have been put in better words than Ghosh. The following passage proves:

The settlers of the Sundersbans believe that anyone who dares venture into the vast water labyrinth without a pure heart will never return. It is the arrival of Piyali Roy of Indian parentage but stubbornly American, and Kanai Dutta, a sophisticated Delhi Business man, that disturbs the delicate balance of the settlement life and sets in motion a fateful cataclysm. Kanai has come to visit his widowed aunt and to review some writings left behind her husband, a political radical who died mysteriously in the aftermath of a local uprising. He meets Piya on the train from Calcutta and learns she has come to the Sunderbans in search of a rare species of river dolphin. When he hires Fokir, an illiterate, yet proud local fisherman to guide her through the mazelike backwaters, Kanai becomes her translator.

The novel Summoning a singular place from history he brings its myth and gives a life to it by making chronicles the saga of just such a group of refugees who were sent by the West Bengal government to Dandakaranya in Madhya Pradesh in 1961 but they left the place and returned to West Bengal in 1978 only to be massacred and evicted again. Ghosh's writing has never had a strict demarcation between fiction and non-fiction. He has always combined roles –that of novelist, journalist, scholar and historian. This novel arrests the novel intertwining accounts of the Morisjhapi Massacre of 1979 in the Sunderbans and the history of river dolphins which are an integral part of history and ecology. Ghosh dramatizes the last phase of the refugee struggle in the Sunderbans.

In the novel, the Morichjhapi Massacre is traced through a witness, Nirmal, and his diary to his nephew (Kanai). we come to know the facts of the incident from Nirmal's widow. Nilima runs a hospital and a trust in Lucibari and is known as "Mashima" (or aunt) to all. She tells her nephew Kanai of the events leading up to the massacre and of her husband's involvement in it:

"In this place where there had been no inhabitants before there were now thousands, almost overnight. Within a matter of weeks they had cleared the mangroves, built badhs and put up huts. It happened so quickly that in the beginning no one even knows who these people were. But in time it came to be learnt that they were refugees, originally from Bangladesh. Some had to come to India after partition, while others had trickled over later. In Bangladesh, they had been among the poorest of rural people, oppressed and exploited both by Muslim communalists and by Hindus of the upper castes"

Ghosh eloquently summarizes the events at Morichjhapi in 1979 through Nilima's narrative. His fictional representation of the event keeps very close

to what actually happened, and he has successfully shown the various ways in which Morichjhapi was markedly different from other refugee settlements. The refugees there were displaced people-they had moved from East Pakistan to West Bengal, from west Bengal to Madhya Pradesh and then again from Madhya Pradesh to the Sunderbans. Yet, in Morichjhapi they had found a place where they no longer at the mercy of the local people or even the government, initially. They found vast tracks of free land in the Sunderbans and created a world of their own. However, the refugees coming to the tide country were premised on a false assumption-they chose this place because they thought that the new Left government in West Bengal would sympathize with their cause. Actually, the government falling short of the expectation of the refugees-not being able to meet their needs or not being sympathetic to their problems-was not a new story in West Bengal. But what happened in 1979, the way they were forcible evicted from the island, was a gross betrayal by the Left government. There was a symbiotic relationship between the refugee movement and Left politics in West Bengal in the early years of independence. The refugees at Morichjhapi showed initiative and organization in their attempt to build a new life. Nirmal, the protagonist of the novel, writes of the refugee initiatives in his diary:

His conscious engagement with the natural world draws our attention to impending calamity of the global environment. The eco-critical investigation figures out that the novel *"The Hungry Tide*" penetrates a picture of man's complex interaction with nature. The Sunderbans in the Bay of Bengal are some islands where people share with animals. The condition of their living is much inferior to animals. The predicament the inhabitants suffer due to unwanted, unexpected tidal surges and tiger attack shows a serious ecological calamity on earth.

The contention that Ghosh, as an anthropologist turned writer, shows an engagement with the environmental decline in the Sunderbans might create an awareness to help prepare action plans for the safety of the settlers. In an interview for Brisbane Festival, Australia, 2004, Amitav Ghosh himself said that he was more interested in characters than issues when he went to write a story. This is exactly true what he maintained in the interview. *"The Hungry Tide*" is not only a tale of settlers and their physical surroundings in the Sunderbans but also an exploration into the hearts of the characters. This fact that the present study detects mental agony of the inhabitants living in a fragile ecosystem is information about the condition of the people; and the present generation can take up fruitful steps to help improve the Tide country situation.

Amitav Ghosh is a writer of postmodern fiction. His stories travel throughout time and space, creating an account that has an asymmetrical flow. In *"The Hungry Tide"*, he shuttles between the Morichjhanpi incident from Nirmal's point of view, and the present day travels of Piya Roy, Kanai and Fokir. This time-travel is vital to the story and created an intricacy of sub-topics and plots. Another trait of Ghosh that is continued in *"The Hungry Tide"* is the scrupulous research that allows a mixture of fiction and fact to the extent that they stand undifferentiated. Touching upon various topics from refugees, freedom and war, to life in the Sundarbans, the absence of language in communication, development, women trafficking and much more, he takes the reader through a whirlwind of events and emotions. He includes the myths of the people who are living in the Sundarbans to explain the nature of living in a country whose shape is determined by tide and weather. The myths are often presented like songs or with rhymes. This style creates different languages for nature, myth and people.

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AN ECOFEMINIST READING OF ANITA DESAI'S *FIRE ON THE MOUNTAIN*

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ABSTRACT

Ecofeminism is a term that links feminism with ecology. This paper tries to outline the fact that the capitalistic society has led to a conflict between nature and culture. This also makes it clear that the exploitation of nature and the oppression of women are closely linked with notions of class, caste, race, colonialism and social rules. Anita Desai, in *Fire on the Mountain* emphasis ecoconsciousness by depicting a serene landscape. She also takes the reader through a maze of human actions, diverse nature of the mountain, the ecological natural processes in the mountain milieu, excessive population disturbing the peace ,man-made dangers exploiting nature; and therefore aims at showing an integral relationship between man and nature. The novel certainly recalls the fact that mother earth suffers just like women living on her, exploited, discriminated, humiliated, raped, disowned, discarded and let to die.

Keywords: Ecofeminism, Anita Desai, Fire on the Mountain.

Ecofeminism is a term that links feminism with ecology. The term is believed to have been coined by the French writer Francoise d'Eaubonne in her book *Le Féminisme ou la Mort* (1974). From arguments that there are particular and significant connections between women and nature, ecofeminism interprets their repression and exploitation in terms of the repression and exploitation of the environment. Ecofeminists believe that these connections are illustrated through traditionally "feminine" values such as reciprocity, nurturing and cooperation, which are present both among women and in nature. Women and nature are also united through their shared history of oppression by a patriarchal society. This paper tries to outline the fact that the capitalistic society has led to a conflict between nature and culture. This also makes it clear that the exploitation of nature and the oppression of women are closely linked with notions of class, caste, race, colonialism and social rules. Anita Desai, in *Fire on the Mountain* emphasis ecoconsciousness by depicting a serene landscape. She also takes the reader through a maze of human actions, diverse nature of the mountain, the ecological natural processes in the mountain milieu, excessive population disturbing the peace ,man-made dangers exploiting nature; and therefore aims at showing an integral relationship between man and nature. The novel certainly recalls the fact that mother earth suffers just like women living on her, exploited, discriminated, humiliated, raped, disowned, discarded and let to die.

A lot of women have led environmental causes and movements such as Arundhati Roy, Medha Patkar, Mahasweta Devi, and C.K Janu. MedhaPatkar leads the Narmada BachaoAndolan, a social movement consisting of tribal people, farmers, environmentalists and human rights activists against the SardarSarovar Dam being built across the Narmada river in Gujarat,India. Mahasweta Devi, is an activist as well as a well-known feminist writer. She has dedicated much of her activism and literature to the cause of betterment of the tribal people and their environment in India. Arundhati Roy, who won the Booker Prize for her *The God of Small Things*, writes for various causes such as the Narmada BachaoAndolan, nuclear testing in India, and the support of the separatists' demand for freedom in Kashmir. Then comes C.K Janu, as recent as the year 2003 onwards, an adivasi woman occupying the Muthanga forests in North Kerala. This was to protest the breached agreement between the adivasis and the state govenrment to provide 500 acres of land to each adivasi family.

In the wake of activists and writers of this kind we find Anita desai portraying the darker shades of nature and the simultaneous conjunction of the darker aspects of the women concerned in her novel *Fire on the Mountain.*The protagonist is Nanda Kaul who wants to enjoy solace on the lap of nature in Kasauli and consider it a peaceful retirement resort after having a life full of troubles and the labour of daily routine. She wants to do away with the disturbing mundanity. She gets a call from her daughter to be ready to accept her great grand

daughter Raka and keep her at Carignano for a while. She, deep inside her heart, did not want the company of Raka who wanted to come to Kasauli because everyone told her that in Kasauli, nature worked wonders. The way the characters are shown bring alive certain situations in their lives and are similar to images as nature has its relationship towards living organisms. The novel depicts multidimensional forms of living. These images have been employed to examine human relationships and their significance. The unconventional choice, of retiring from the family's responsibilities, made by Nanda may not be highly appreciated but she is forced to come to a compromise. She is quite sure that she has completed her duty in life by seeing her family and kin well cared for by herself through out her life and takes a decision to "be left to the pines and cicadas alone she hoped she would not stop" (3). She is pleased and satisfied with the place and landscape around her. "Everything she wanted was here, at Carignano, in Kasauli. Here, on the ridge of the mountain, in this quiet house" (3). Due to the passage of time she enters in the world of old age. She embodies a tree out there to bear the unpredictable seasonal difference of life. "Whatever else came, or happened here, would be an unwelcome intrusion and distraction"(3).

She is grey, tall and thin and she fancies "she could merge with the pine trees and could be mistaken for one. To be a tree, no more and no less, was all she was prepared to undertake"(4). Nanda is attracted to Carignano for 'its barrenness that equalizes her. The lonely house is symbolic of the solitary life of Nanda.

Anita Desai has correctly brought out the sight of an eagle or a bright hope served to delight her otherwise solitary existence. Ecocriticism evolves not only through the ecological concerns but through description of landscape and imagination of nature and climatic intervention. It draws a meaningful link between animate and inanimate relationships.

Desai's novel is a blend of nature and characters and her novel is rich in exotism that they represent their own individuality. Man has turned into a machine now because life has started to depend more on technology than on anything else. Human beings are ussing natural resources to satisfy their own needs and desires. In Carignano once upon a time garden house was the most beautiful garden in Kasauli, now it has been used as an army camp. It clearly depicts the insensitivity of man towards nature and patriarchal attitude in destroying the natural phenomena. Literally man has exploited nature like an object for his own pleasure. Here Anita Desai wants us to draw the attention of the degradation of the ecological balance. She depicts the aesthetic experiences drawn from the nature and that makes the human beings live in peace and harmony regardless of our pathetic life in the world. In fact Anita Desai has incorporated environmental attitudes in her novels, which speak about animate and inanimate things that surround the entire natural ecosystem.

When Raka slipped out of the window to have a better look at the landscape on her first expedition to study the mountains she saw:

Shoals of rusted tins,bundles of stained newspaper,peel,rags and bones,all snuggling in grooves, hollows, cracks, and sometimes spilling. Pine trees with charred trunks and contorted branches, stiking melodramatic attitudes as on stage."(46)

As soon as Raka looks at the landscape, these are scenes that evolve in front of her and she wondered why Great grandma had never seen the factory or the ravaging of the near by ravine because of the waste dumped by the factory workers or the gutter that carried the dirty water to the rivulets nearby. She feels her father and grandmother had extolled the beauties of the Himalayan Hill Station to her but never said anything about the factories.. Anita Desai remarks: "To her, it seemed to dominate the landscape-a square dragon, boxed,bricked and stoked"(46).

She even asked Ram Lal the caretaker why the factory emitted so much smoke. He explains that they made serum for the whole country and remarked " See those chutes? They empty the bones and ashes of dead animals down into the ravine. It's bad place.Don't go there."(47).

Even the air smeltof cinders, serum boiling,chloroform and spirit,dog's brains,boiled vats,of guinea pigs' guts and so on. How can the Himalayan beauty which is an unsustainable view for an English artist, where hills melted into sky, sky into snow, snows into air be considered retain her serenity with draconian invasions such as this?

Another blow to nature in those divine mountains was the burnt black shell of a house. It was burnt down in a summer fire when there was no water to fight it out. Then comes the once upon a time beautiful Garden House of Kasauli turned into an army bill*et* The area has an atomic reactor and lot

of barbed wire around. Changing the quiet, complacent and peaceful area into a war zone.

The novel goes on to bring Ila Das to visit Nanda. She is the Welfare officer of the Government and tries to educate people to take a child infected with tetanus to the clinic straight away. But superstitious believes take more time before he could be taken to a doctor and the boy dies. She also tries to stop a child marriage and ends up having enemies she herself is not ware of. She tries to tackle the father Preet Singh but could not convince him.

The night she returns from Carignano she gets late after buying things, even the footpath already was lost in the evening shadow of the mountains. She stumbled over the pebbles and rocks.. She is accosted by a man who held her throat hard. He tore at her clothes, rapped her,pinned her down and strangulates her . She dies. This brings out the punishment given to her by a dominating male figure of the locality for intruding into his affairs. He has been a beast in his reaction not understanding that Ila Das had after all tried to save his own child from misfortune. He had no foresight, no forethought nor any understanding of what the future had in stake for his daughter, but his patriarchal ego would let his inner eye open up.

The novel ends by depicting Raka taking a match box from the kitchen without the knowledge of Ram Lal and setting fire to the dry grass in the near by forest. The flames spread down the ravine as she runs home and tell Nanda "Look Nani, I have set the forest on fire. Look, Nani-Look-the Forest is on fire" (159). Perhaps she felt the clumps of trees, the ravine, the hill tops and the rocks never had anything positive now to offer as where ever she turned there was only dryness, stench and destruction of nature.

So is the plight of Nature. Man is tearing at nature, the green mountains look plush and miraculous, but a closer look will reveal the sickening silence in the face of the ravines polluted with remains of dead animals and strains of chemicals being sent out of the factories .The hill-tops seem to radiate with willows and flowering plants but they had frizzled grass and blazed rocks, bleached and blackened by fire. Man has driven the divine out of the hills , torn at her , sent out the sweet fragrance and filled her with filth, made her dry, dusty, dull and drained of all the goodness; There was no song to sing of her, except that she has been cheated. In the name of enjoying her company she has been devastatingly exploited, to only be expended and then to be put to an end. Ecology and Ecofeminism go hand in hand. Just as man destroys the essence of womanhood by ill treating and abusing her ,he also gives devastating blows to nature by using her too much without thinking of providence. Leaving us wondering how mother earth suffers just like women living on her, exploited, discriminated, humiliated, raped, disowned, discarded and let to die. If there is no importance given to feminine values such as reciprocity, nurturing and cooperation, which are present both among women and in nature the globe will soon lose its charm and to what end… is a million dollar question.

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GOD APPEARS IN ALL: JULIAN BARNES' A HISTORY OF THE WORLD IN 10½ CHAPTERS

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ABSTRACT

The creator of nature, the God is the Father of all, the Creator of the Universe and the Supreme Deity. He is also the Father of Jesus Christ and Saviour to His followers. God is seen in many ways, through miacles, such as the appearance of the butterfly when a crew is desperately lost at sea, the rainbow as a covenant to Noah, the actions of the raven and the dove. The present paper focuses on the presence of God in *The History of the World in 10½ Chapters* by the contemporary British novelist, Julian Patrick Barnes. The novel with ten and a half chapters represents the trust and faith towards the Supreme Power by means of water. Barnes refers Him directly, indirectly or through the use of metaphor in every story of the novel. The paper draws attention on the actions of the God in the chapters of the novel with regard to nature.

Keywords: God, Nature, metaphor.

Julian Barnes, in his novel, *The History of the World in 10½ Chapters*, represents the creator of the huge ecosystem, the God and the deluges those happen at the seas. The animals, behemoths, mankind are read between the historical and modern periods.

The book begins with the nature-creator. God referred throughout the novel by Barnes, appears to be the Christian ideal of God although other faiths and cultures are mentioned. In the Christian view, God is the Father of all, the Creator of the Universe, and the Supreme Deity. God is also the father of Jesus Christ, Lord and Savior to His followers.

God may be seen in many ways, through miracles, such as the appearance of the butterfly when a crew is desperately lost at sea, the rainbow as a covenant to Noah, the actions of the raven and the dove. It was God that spoke to Noah about the Great Flood and instructed him to build the Ark. The woodworm had differing tales than Noah, but along the line all seemed to agree that God had some part in the ark building as well as getting everyone and thing that was left safely to shore.

God's wrath may also be seen in regards to the Great Flood or the Great Deluge that completely flooded the earth, except for a select number of animals and the family of Noah. It can also be seen in the violent weather and bad luck that befalls certain people.

He is referred to in every story whether it is directly, indirectly, or through the use of metaphor. In many of the stories it is clear that God is being referenced directly. This is seen mainly in the discussions of religion, such as in "The Wars of Religion." It is also made clear in the tales directly involving Noah's Ark - "The Stowaway", "The Mountain" and "Project Ararat."

Noah was the one chosen by God to save the animals and humans from the Great Flood. Noah was said to be sage, holy, and basically beyond reproach, therefore being the perfect choice to carry out the grand mission. Noah was instructed to build an ark and take aboard his family and two of every type of animal so that the planet could be re-inhabited without the wickedness of those left behind.

The author sees a different side of Noah, and certainly one less flattering than the one in the Bible and other texts. Noah's character is brought into question by the narrator who obviously was not fond of the man. "Noah - what point is there in not telling you the truth? - was bad-tempered, smelly, unreliable, envious, and cowardly." (*HWC* 16)

The sea is the setting used in all of the stories, at least in part. When one refers to the sea, it often means an ocean or other large body of water which may be another type of body of water. The sea is the greatest enigma on earth. It is a paradox in that it can be gentle and beautiful or violent and ugly. Its creatures are too vast to be counted. The perfect example of this can be seen in "The Shipwreck". The crew of the Medusa first encounters a school of porpoises and later experiences the great strength of

a deadly shark. The sea is the giver of life to thousands of species of creatures, yet it cannot or will not support mankind.

Although some of the sailors throughout the stories are seasoned navigators, others are not. In the case of Noah, the time at sea was not several months but 5½ years, according to the woodworm. Others tossed themselves into the sea either on purpose or through some unfortunate accident. It is clear that the sea was not always accommodating to those not native to its waters.

Arghuri appears in "Stowaway", "The Mountain", and "Project Ararat". This location is where the people from Noah's Ark settled after the end of the Great Flood. It is also a town visited by many on the way to Mount Ararat.

The island of Aix appears in" "Shipwreck", "The Mountain" is the port in France where the sailors of the Medusa set sail in 1817.

Medusa appears in "Shipwreck" in which the ship sailed from Aix. The ship, part of a four ship flotilla, ended up in a shipwreck immortalized by Gericault.

Greece appears in "The Visitors" that is the final destination of the Aphrodite Cultural Tour led by guest lecturer, Franklin Hughes.

Ararat which appears in "The Stowaway", "The Mountain," is the mountain on which Noah's Ark supposedly settled. For thousands of years people have made pilgrimages to the site.

The natural ecosystem, the God and the sea (water) are related with mankind right from Noah's period till date. This has been depicted by Barnes with the aspect of interpretation of the natural history. The author presents the induction of various animals and human kinds of a different era in the novel. This showcases diversified natural ecosystems that could be seenrepresented all through the novel in huge deluges and other catastrophes.

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PORTRAYAL OF WOMEN AND NATURE IN KINGSOLVER'S NOVEL *FLIGHT BEHAVIOUR*

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ABSTRACT

Literary eco -criticism is concerned with the ways that the relation between humans and nature are reflected in literary texts -the relationship of human beings with each other and with their environment. Literature has rich ecological heritage because literary history has many works on romanticism, naturalism, transcendentalism, literature of landscape and frontier literature. This paper aims to portray how Kingsolver used women and nature in her novel *flight behaviour*.

Keywords: Ecofeminism, American Literature, Kingsolver, Flight Behaviour.

Eco-feminism is to redefine how societies look at productivity and activity of both women and nature who have mistakenly been deemed passive, allowing for them both to be ill-used(Shiva 157).

Ecofeminism is one of the types of feminism. Ecofeminism is a combination of feminism and ecology. Feminism had little concern for the nature g the first and second level of feminism writers almost said little or no attention to women, animals or ecology . But, the third level of feminist connect closely with ecology. Eco feminism is relatively a new part of feminist movement. It evolved out of the political activism over the past three decades. Eco feminism explores the internationality between sexism, the domination of nature, racism, and other characteristics of social inequality.

Ecofeminism as a social and political movement points to the existence of considerable common ground between environmentalism and feminism with some currents linking deep the ecology and feminism. Eco feminists argue that a strong parallel exists between the oppression and subordination of women in families and the degradation of nature in the society. Nature in literature is however portrayed right from the classical aid and reshaped in each age . However, nature flourished and represented as the most important feature in the major writers of the Romantic period. Romanticism proclaimed the love of nature, freedom and individualism. American writers greatly emphasized the importance of nature and the primal feelings of awe , apprehension and horror felt by man on approaching the sublimity of it. They not only appreciated nature for its visual beauty, but also revered for its ability to help the urban man fine his true identity.

Nature is feminined because it is seen as possessing the same qualities as women. One could see the different dimension of women and nature. Women tend to take a secondary place in the society and also tend to be equated with nature. Thus, women and nature were inspiring and being on the losing end on both fronts and fighting the same battle against oppression. Eco feminism is a significant branch in eco critical study. Eco feminism as a social, political and academic movement focuses on the oppression of women and the exploitation of nature as being interconnected. Eco feminists argue that any attempt to liberate women will not be successful withstand equal attempt to liberate nature.

Many feminists make a verbal connection between elimination0of women and domination of nature. Ecofeminism is based on certain fundamental claims that pointing the existence of important connections between the oppression of women and nature. It is essential to understand the nature of these connections in order to understand the oppression of women and nature.

Kingsolver is a American novelist, essayist and po*et* Her works often focus on social justice, biodiversity and interaction between humans and their environment. Many of her works display her thorough knowledge of biology and ecology.

This paper focus on Kingsolver' s novel *Flight Behaviour* . It deals with the possible effects of global warming on the Monarch butterflies and the significance of growing awareness of climate change impact on people's life . In this novel Kingsolver shows how environmental awareness significantly changed protagonists life positively . Dellarobia

Turnbow is the central character. She is well observant but poorly educated young mother living in the rural community of Feather town, Tennessee . She is a sheep farmers wife. She faces a hard life staying in that sheep farm looking after they children and the household. Dellarobia's transformation in her life came when she encounter the view of million of butterflies imagining on tree leaves . Their usual migratory route has been disrupted, and what looks to be a stunningly beautiful view is really an ominous sign or ecological disaster. The sudden pain and cold of Appalachian winter could be the demise of this delicate species . They have to move away from that mountain looking for a warmer place. She was quite able to relate the environmental disaster of landslide and flood which occurred in Mexico which is the habitat ed these butterflies. She realised the fact that "when you clear-but a mountain it can cause a landslide"(234).

Dr. Byron , an entomologist , arrive to study those monarch butterflies and tries to find out the season behind their sudden and unexpected visit to southern Appalachian mountain. He unfolds the mystery of mass extinction of these colourful species because of drastic climate change. Dellarobia environmental consciousness makes her save dying butterflies. "What was the use of saving a world that has no soul left in it. Continents without butterflies and sea without coral reefs"(438) . These lines shows the people's anthropocentric attitude towards nature.

This novel shows the environmental awareness.. especially the female protagonist Dellarobia's environmental consciousness and personal growth as an independent woman. She participated in contemporary environmental protection and preservation act. Her personal development comes through her transformation into an environmentally aware individual. In this novel, environmental awareness and global responsibility plays vital role in Dellarobia's life. Dellarobia's journey from a distracted, unhappy farm life to become an environment conscious person tells the story of self-consciousness towards natural environment .

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PSYCHO-SOCIAL PERSPECTIVES IN TANYA MENDONSA'S THE DREAMING HOUSE

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ABSTRACT

Tanya Mendonsa is a prolific contemporary writer, an abstract painter and more than everything, a lover. Two volumes of her poems entitled *The Dreaming House, All the Answer I Shall Ever Get* and an enchanting narration *The Book of Joshua* are published so far. A writer's role to his/her role is inevitably a contributing one to her society.

The object of "peeling back the layers of personal memory and experience" helps in understanding "the often irrational roots of human motivation, thoughts, and behaviour" (Kandel). In coordination with personal memory, Mendonsa's early life and way of upbringing can be considered with relevance to the context of psycho social impact of nature in literature. In *The Dreaming House* she records the pattern of a true nature lover throughout her poems. In other words, "[T]he near and the remote are yoked together" in the poems of Tanya Mendonsa (Prasad 104).

Keywords: psycho-social, man-animal conflict, Tanya, Nilgiris.

I am a walking illustration of all that I love (*DH* 122).

Tanya Mendonsa is a prolific contemporary writer, an abstract painter and more than everything, she is a nature lover. Two volumes of her poems entitled *The Dreaming House, All the Answer I Shall Ever Get* and an enchanting narration *The Book of Joshua* are published so far. A writer's role to his/her role is inevitably a contributing one to her society. More than writing, every literary piece functions as a medium for teaching, over which Maya Angelou appropriately reflects in the following manner, "When you learn, teach" (Winfrey viii). When the objectives and the subject matter of teaching has been so far conceived by the act of learning, the prime objects that make one learn should be taken into consideration. There are so many aspects in this universe that makes an individual undergo the process of learning. When narrowed towards ecocriticism and its salient features, nature has always been one's teacher. One's environment plays a significant role in enhancing human capability to understand things. Further, "[I]t is now accepted in the scientific community that our environment shapes the expression of our genes and that specific experiences of interactions with the environment affect the laying down of the neural circuitry of the developing brain" (Benoit).

Human psychology is influenced by varied factors among which the most prominent one is personal memory. The object of "peeling back the layers of personal memory and experience" helps in understanding "the often irrational roots of human motivation, thoughts, and behaviour" (Kandel[1]). In coordination with personal memory, Mendonsa's early life and way of upbringing can be considered with relevance to the context of psycho social impact of nature in literature. Apart from her rich experiences as a painter and a founder of a language school in France, her childhood experiences determine her present life in the Nilgiris. Her frequent visits to tea estates owned by some family friends in Darjeeling inspired her a lot. She demarcated the buzzing streets of Calcutta (now Kolkata) and the peaceful tea estates in Darjeeling that made her to decide upon her destination. Further, her interest in literature can be seen in her efforts to set up a lending library in Bangalore. She combines the wishes of her soul for a peaceful life and her interest towards literature into a perfect blend which is being expressed through her nature poems.

Mendonsa seeks asylum in nature and wishes to see the diminishing image of cities. Nature in its vast design is known for its plurality and there are several instances where man has lost in its wilderness. Rabindranath Tagore realises the Almighty in every aspect of nature. He says, "Like a rain-cloud of July hung low with its burden of unshed showers let all my mind bend down at thy door in one salutation to thee". A momentous view of woods on a snowy evening demands Robert Frost to halt and withdraw from his everyday duties, of which he

utters, "The woods are lovely, dark and deep". In the case of Mendonsa's poems, the poetess feels the other way around. She senses herself complete amidst nature but when she goes into cities she feels "like a lost text" (*DH* 122). Her expressions in the poem "When I Go into Cities" highlights the psychological barriers to get mingled with the abstract aspects of mechanised life. It is evident from her personal experience where she abandoned the over-developed cities of Bangalore and Goa in order to settle on the pleasant blue coloured hills of the Nilgiris.

Meanwhile, Mendonsa adheres to hedonism[2] which is claimed to be a prominent characteristic of a postmodern man. Terry Eagleton comments that, "[R]ightly or wrongly, Freudian theory regards the fundamental motivation of all human behaviour as the avoidance of pain and the gaining of pleasure; it is a form of what is philosophically known as hedonism" (166). In spite of the negative façade of postmodernist hedonism, the aspect of seeking pleasure through nature proves to be a positive one. The features of hedonism are revealed in many of her poems, say, "Oblomov"[3]. The major character Oblomov is reluctant to get off his childhood days. He is not fit to be as realistic as others are. However, Mendonsa represents him to be a happy man. The following expression illustrates how Oblomov seeks pleasure in his own ways which are of course the features of nature:

There, he is caught forever in that golden moment
where it is always summer.
Always the dacha in the country.
Always the blissful boy with arms flung wide in his white shirt,
running through the sunflowers,
running home to perfect peace… (*DH* 9)

Mendonsa's objectives and her reflections towards nature are clear from her free verses. In "Divorced from Green", she throws light upon the crucial time while man parted himself from the objects of nature. The core idea of her poem is expressed from the following lines, "The feet meet cement / and are forever divorced from green" (*DH* 5). From the above illustration, it is evident that man deserts one means when he is efficient enough to explore other with less efforts. Similarly, Winston Churchill reflected on this tendency of a postmodern man by claiming that "food will be produced without recourse to sunlight. Vast cellars in which artificial radiation is generated may replace the cornfields or potato-patches of the world" (291).

Mendonsa's experience in Nilgiris makes her also to reflect man animal conflict. Man's aggressive tendencies are often expressed whenever he feels insecure. His insecurity can be witnessed when his boundaries are shared by someone else about whom he is uncertain. For instance, when a snake enters his garden he is rather scared that makes him grow furious against it. He acts even weirder than ever when the species of his own trespasses or occupies his boundary. In this way, man retains his animalistic tendency which he inherits as a descended species as a part of evolution. Henceforth, it is an ordinate fact than each living being should have its own territory to live within. This makes one to understand that a perfect balance should be maintained in order to ensure a peaceful living. It is clear from Mendonsa's statement claiming love towards animals is essential in order to respect them: "I'm not afraid of the "wild animals" but, as an animal lover, I respect them, which means I keep them at a safe distance, unlike our mountain mongrel Ninotchka, who is fearless and has learned to rue her bravery after being charged by a baby bear" (Sibal). She registers a concrete opinion that is psychologically influenced by the society of man as well as animals. Her expression on her beloved pet shows that mutual understanding also exists between a human and a non-human being:

We both laugh with joy at nothing: just happy to be alive.
Who will laugh with me, in perfect unison, when two becomes one?
If I gave you half my lifespan, we could go out together:
close our eyes and leap the chasm together,
into that other world
where two into one
is one for evermore. (*The Book of Joshua* x)

The above poetic expression can also be analysed by depriving the man-centred notions. In the world where a lot of animals are being slaughtered for various purposes, a dog named as Joshua has influenced Mendonsa's life to a very great extent. Jilly Cooper comments that "[A]ll dog lovers will rejoice in this charming and funny book" (…). Therefore the book is not confined to the thoughts of an individual but a representation of animal lovers, especially of dogs. This shows that when a non-human like Joshua deserves love of a human like Mendonsa, there is no doubt that Joshua also has a tendency to love back, to play with, to inspire and to stay in harmony with human beings. From an ecocritical perspective, it can be said that rather than human beings, animals deserve the love of animals. It

is because love is not reserved to mankind but also an inevitable component of animal societies.

Poetry of the twenty-first century is a mixture of war poetry, romanticism, postmodernism, supernaturalism and evidently a conglomerate mixture. Mendonsa shares a common way of perception with Ruskin Bond but exempting his lighter vein in expressing serious aspects of life including culture, poverty and death. Bond says, "My life has been one long love story, and I have loved people, I have loved books, I have loved flowers, the sun, moon and stars, old roads, old tress, children, grannies, butterflies, seashells, fairies… And of course I keep falling in love, for where love begins, there is the border of heaven" (Bond x). Similarly, Mendonsa's interest and knowledge in various things are expressed throughout her poems. For instance, she speaks of human relationships in "The First Lie", illustrates the negativity of scientific advancements in "Oblomov" and "Divorced from Green". She includes supernatural elements in "The Queen's Bath" and "Moon Struck" where she also uses transcendental ideas and her poems "Night Voyage in Middle", "The Past is a Foreign Country". However, she records the pattern of a true nature lover throughout her poems. In other words, "[T]he near and the remote are yoked together" in the poems of Tanya Mendonsa (Prasad 104).

Psycho social is ultimately an analysis of the relationship between the individual's emotional needs and the social and emotional environment around the individual. In the light of the personal and social life of Mendonsa, one can analyse *The Dreaming House* alongside Erikson's point of view. He has stressed the importance of social interactions in the development of a person's life. According to him, "a psychosocial moratorium during which extremes of subjective experience, alternatives of ideological choice, and potentialities of realistic commitment can become the subject of social play and of joint mastery." (Erikson) Mendonsa's choice of leading a nature filled life is an example to it. Further, Erikson also warns that if the attribute turns to be negative, what Erikson calls as dystonic, it "may manifest itself in impaired self-concept, adjustment problems, and possibly, psychopathology". ("Erik Erikson's Theory of Identity Development" 46) . Mendonsa's poems "Divorced from Green", "The Scarlet Thread", "The Past is a Foreign Country" are examples of her aches of an artificial chaotic life. On the other hand, the "subjective experience" in Bangalore and Goa has led to "alternative" of Nilgiris which helped Mendonsa to gain mastery in her life. "The Delectable Blue Mountains" and "Alone in the Jungle" are examples to prove how Mendonsa was able to delve into the proper channel of life. The psychological and the social in her life have culminated in the writer settling down in Nilgiris and authoring books on her psycho social travel.

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VIRGINIA WOOLF'S GREEN VISTAS IN "MRS. DALLOWAY"

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ABSTRACT

God created women in the incarnation of himself how flowers are soft and tender women's attitude also springy and gentle. In every bud beautiful flowers hiding themselves like in every woman their powerful attitude towards nature are camouflaged, their potentiality will prim out automatically in a needy situation and they shine beautifully like full bloomed flowers in their looming. Women are like grey, white moths in the earlier phase without maturity, they may act childishly. But through their full prime of life and progress, they turned into the spectacular multihued butterfly and they burnish glowing in their society and family life. That's the attitude of Clarissa,who behaved has a moth in early stage, thenmatured as a full blown fantabulous butterfly by giving the party. The novel "Mrs. Dalloway" starts and ends on the same day by narrating how human beings are close with nature and how they preserve and conserve our environment..

Keywords: Incarnation, nature, bloomed flowers, preserve, conserve.

In Virginia Woolf's *Mrs. Dalloway* Clarissa is spunky and accrue with nature. In the starting of the novel she is looking at the Bourton city through the windows. She feels more contentment by hearing the hinging sounds of lark and plunge which made her mind urged to kiss the flapping and chilling sharp waves as to breathe the fresh open air amidst nature. She adorns the renewed and calm cooling air that made her lively. But a glimpse of smoke struck into her mind by thinking Peter Walsh her ex-boyfriend who said, "Musing among the vegetables?" – was that it? - "I prefer men to cauliflowers" (M.D7).

Clarissa feels that her life would vanish like a cabbage. Though few people are more important in our past, they would never become closer in the future. Everything would change like the climate that it had its own miracles. Her age is described with a touch of bird with bursting jay, green-blue, light, vivacious and white at the age of fifty. Her heart is hushed with the irrevocable musical warning which boomed with big ben influenza. By visualizing the Victoria Street her heart would flutter like a bird and made her memory afresh. She primed her dejection and miseries into a positive note and started to love her life.

Mrs. Dalloway starts in the middle of June by stating the war was over by taking the precious life of John a young soldier. It was the early June the King and Queen feel more comfortable in the palace. There she heard the beating sound with a striking of bouncing ponies and the cricket bats are tapping all meshed with the grey- blue morning air. Girls are laughing and dancing with their transparent muslins. The absurd woolly dogs are running around that place. To kindle and illuminate that precious time Mrs. Clarissa arranged her party with the absurd and faithful passion.

In her life she had a positive attitude of the trees in her home. Though she never familiar with some people who are crossing the streets which made their passing as branches of trees left in the mist and their memories spread all over her accolades. The recollection of the books and the glimpses of people, which made her mind to visualize the white dawn country image with full of vitality and hope. "Fear no more the heat o' the sun, nor the furious winter's rages" (MD 13).Though climate is having so many changes, our human life is also fixed with changes and endurances. We have to accept the reality and make ourselves suitable to the situation and adore to the nature.

She smelt the irises and roses and up roaring the delicious scent of fresh flowers which proliferates her coolness as frilled clean linen laundry. She associates the city life with the mess of nature. For her, nature and present modern mundane life are part and parcel it would never be separated from her. Her novel is filled with musical rhythm which made the readers jump with rhyming in their heart, which art and nature would never be forfeited.

Clarissa felt extreme happiness by seeing the floral arrangements of dark and prim carnations, roses which holding their heads with pride and sweet as peas in their bowls, tingled violet and snow

white pale that made viewers' eyes enchanted with visual treats. On a sunny summer evening girls came out to pick sweet peas and roses and they enjoy the blue black sky. By the time six and seven all the flowers expose their majestic pride and beauty of nature by their bursting blossom. The flowers like roses, carnations, irises, lilacs which filled with the gorgeous colours like white ,violet, red and deep orange . Every flower has its own individuality.

While Clarissa enjoys the gentle and stunning scented colourful potty flowers she was disturbed by the wavering pistol shot from the outside street which lingered nonsense in her monster mind. Yet she is in London her mind rests in peace only with the acquaintance of nature. Miss Pym peeped outside to witness the incident but the crowd and modern degradation of the environment created the mess and made the passer by invisible, inaudible, swift and veil like and nothing to be seen as a square of dove grey. Nobody knows the face that came there.

In a sunny, hot summer Septimus Warren Smith about thirty blocked the traffic from his throbbing motor engine which would sound like pulse irregularity in a body and his Italian wife Lucrezia insisted him to clear the accumulated traffic. Everyone looked at his motor car which would create a curious pattern like a tree. They were never noticed who is inside and it would create curiosity in everyone's mind whether they may be a king or queen. The mystery hidden in the car is not seen by anyone. London is the city with full of greenery and it's now filled with dust because of the innumerable motor cars and antiquaries that would be ruined by the time.

To facilitate his ecstasy Rezia puts her tremendous body weight on his knee and made him to feel the excitement of the rising of elm trees. Which made the leaves falling, rising and falling with all their leaves flaming with beautiful colours which is changing from thickening blue to green like a hallow wave, plumes of horses and feathers on ladies' heads. He played with his wife so gladly by rising and falling of a superbly elm tree which made him mad. He shut his eyes and he enjoys the environment so pleasing with his wife. Nature gives full enjoyment and bliss to our soul, it acts as an energy tonic, if we fell misery and gloom once we get back to nature all our endeavors would set back again.

They gestured that leaves are lively; "trees are lively and each leaf is being linked by millions of fibres through his body". While they spend their time with nature thousands of nerves in their body connected with thousands of roots and fibres of valuable trees. Once we are with nature, we feel the pleasure and our mind is completely get out of our mundane pressure and it reaches its ecstasy. There is close bondage between man and nature no one split away from it. Once we realize its value and we get back to nature automatically so many worries would come to an end.

While he sat on the elm tree which stretched and fanned up and down and made him to realize his liveliness. He also comes across the sparrows fluttering, rising, and falling on the jagged at the fountains and it created a new pattern and made his mind flutter like birds. The branches are black, birds are white and blue, and it's a beautiful sight for the observer. The amazing sounds of birds made harmonious premedication, altogether with the child's cry, and the horn sound all joined together given birth to the new religion.

Their innocent way of enjoying nature was noticed by others so she wants to walk on the back of the fountain. Rezia felt heavy in her heart by stating the real attitude of her husband. Though she sat beside him, he is not looking at her and he never feels her presence. That makes her more terrible. He is enjoying the sky and tree, children playing, blowing whistles and he is now not acting in his present situation and he is far away from reality. To her mother too, she is telling he is working too hard. That's too much of love that makes solitude, and they expect the same from the opposite.

Septimus tried to kill himself and Dr. Holmes advised nothing was matter for him. But he is not the man, who is not a week in his heart, but he feels happy without her company and he never needs her. She felt lonely in her heart and she never wants to leave her husband alone, which made her lose her weight. Her wedding ring fall from her finger that much she lost her weight. The truth hiding in her heart without revealing to anyone made her life miserable. She was worried about he is not noticing her new hat and lace collar. Nothing would make her happy without him, but he is enjoying everything in spite of her.

Rezias at in the Milan garden and she hugged in chairs and she "looking at a few ugly flowers stuck in pots!"(M. D.28). For her, nature is not that much pleasing as her husband. She feels people who are here are half alive because they are doing their work and walking in the crowded streets

and laughing aloud which made her to think so. Virginia's *Mrs Dalloway* is sound in rhythmic style and evokes a poetic sense in all readers' heart. Her narrative technique is exuberant and mind throbbing. Her characters are lively and we can feel their mind and pain. Virginia made us to see the characters through her eyes and each minute detail is not escaping from the eyes of the readers.

"Men must not cut down trees. There is a God"(M.D. 29) he saw God in every tree. As Vallalar Indian sage mentioned "Whenever I saw causing crop my heart hurts".(T.verses 3471)Septimus wants to change the world and he feels no one likes to kill somebody because of hatred. Then what made him to cause environmental damage and cutting the everlasting trees. If we would never preserve our environment for our descendants then they have to face its consequences.

As he got some message from heaven, he listened quietly to the nature and he takes down the notes. For him, service to entities is service to God .He can hear his name was perched by the sparrow four to five times and it sing fresh and probing notes in Greek. Another sparrow also joined with it and prolonged the penetrating verses in Greek. These birds made his name eternal and there is no death in nature and it will survive up to the last day of the world. If the landscape wholly destroys no species would survive in this world. Then it would be the final destination of the universe.

Septimus feels there is no death for the nature observers and he feels meadows are having a life beyond the river and they can walk through the death. By his occurrence of the word death made hesitant and she asked what he said with sudden irruption. He really wants to get out from the people and he wants to take a rest beneath the trees which are dipped its green stuff with a ceiling cloth of blue and pink smoke and created rapport in his mind. He then happily watches the long necks of Zoo animals which are paling, barking and howling and he observes everything under the tree.

Rezia feels Mrs. Dempster had a sardonic way to look the roses. Our life ends with eating, drinking and mating. All our lives are not beds of roses. And she feels pity for someone who is not having roses and they lost it. "Pity, for the loss of roses".(M.D. 32) and she pitifully standing near the hyacinth beds. She longed to see the foreign parts. The sight of the aeroplane which is fast and fading which made her to recall the little grey churches, on either side of London and on the other part there is dark brown woods where there were many adventurous thrushes boldly hopping and the snatching of snails which is tapping on a stone.

The moments in her life are like buds on the tree of life. The flowers are in darkness, she is expecting her lovely rose would be blooming soon at least in her eyes. She believes in god for a moment how we are waging our servants, god also repays us by his mercy by giving her cherishing husband, Richard who was the foundation of her green lights of her life. Lady Brutonasked to Richard whether he would have lunch with her. The concord between Clarissa and her husband is thinking in gentry love and glided with calm and peace. Mrs. Dalloway is honorably taking her battle as a role of his wife and placed an umbrella stand. Often she repeats "Fear no more the heat o' the sun" (M. D. 35)Lady Bruton's lunch with her husband shook her a little as a plant on the river bed side and it shivered and rocked her and she is not moved by any vulgar jealousy. But she fears about the dwindling time, which would give lot changes in her attitude of lady Bruton.

The phrase of Woolf's is peppered with moments of being in our real life. Her works melts away our heart and she helps us to think what she has in her mind. She is extremely good at grasping and delivering the image with musical note and the readers feel more amazed by her narrative technique. Clarissa's presence with her husband is too intimate as "a match burning in a crocus" (M.D. 37). While she reminisce her profound loveliness it dwindle as quickly as it disembark.

Clarissa loved Sally because abandonment beauty which everyone would envy her. Sally has her amazing power as a gift to her personality. Sally has her own approach to flowers, she kept her little vase on Bourton table and she picked hollyhocks and dahlias and all sorts of ever seen flowers altogether. She cut the tops of the flowers and she made it to flow on the bowl. Its effects reveals on the extraordinary evening sunset dinner. The purity and integrity are two things Clarissa thought about Sally. It is the pure quality which, besides found among the women and women. Before marriage, though Clarissa was absurd she was charming and overpowering and she shouts aloud "She is beneath the roof… She is beneath the roof!"(M.D.39). But those happy words and memory is nothing to her in the later part.

Women in her childhood used to spend her time with her family members and friends. She has actively taken part in all the activities by showing

her hidden potentials. But in her later part her acquaintance with her friends and relatives stand in the corner and her husband takes the upper hand over her life. The importance has entirely changed in the second part of her life. Her life occupied by her husband and her children. A woman is compared with a sapling. How it grows, she also reached her womanhood. How the tree bare fruits, Woman also delivers her child. As trees are always useful to the society women also heave her children and played a vital part in their family.

By hearing the pattering, rustling and the thudding sound of the leaves in a wood his thoughts drummed and overtook him and he praised the fidelity for his love for England. The marching of the young guys to the Whitehall with uniformity in arms and legs made him to think our life with irreticences to pay tribute to the great leaders. Staring corpse and discipline it would make someone laugh, but it reminds them shivery and to respect their pavement of the exalted statues of Nelson, Gordon, Havelock, The black and the spectacular images of great soldiers. Peter always had praise for Gordon. Hi statue looks one leg raised and one arm crossed it always made him to pity Gordon.

The only person who knows his arrival in London is Clarissa. After his voyage his native place seemed an island to him. He had his strangeness that he had stood alone, but with full of liveliness in Trafalgar square. He sat in the Regent's park and recalls her introduction of her daughter. She seemed eighteen years old. She seemed handsome instead of pretty. She is not equal to the beauty of her mother, but she feels more proud about her daughter. Then he smokes the rich benignant cigar and he coolly puffed it into blue circular rings. His mind swept with moving branches, children's voices and shuffle of the feet and humming rising and falling of traffic.

While sitting in the Regent's park his recollection with the past is unavoidable. Clarissa always talks, praise about her father and their possible, arguing about the politics and spend their happy time in that park. Those moving branches shook his memory from the past and wavers his mind. He considers himself as a solitary traveler. Throughout his life he travelled alone without anyone's company which made him feel lonely. Though few people appeared in his life their part in his life is momentary and not permanent.Nature plays a vital role in every character of this novel and it made the readers to visualize it's and power. Thus I conclude Virginia's green vistas is spread though out this novel and made us to enjoy its magnificence.

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ECOMASCULINITY IN EDWARD ABBEY'S FIRE ON THE MOUNTAIN

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ABSTRACT

This paper makes an attempt to analyse ecomasculinity in Edward's Abbey's *Fire on the Mountain*. The natural environment and ecology are altered by man either positively or negatively depending on what man thinks about himself in relation to nature around him. The relationship between nature and culture in intimately woven and any attempt to severe the bond could be disastrous. Man's peaceful co-existence with nature makes him realize the importance of maintaining the ecological balance. However, indiscriminate poaching, deforestation and other exploitative activities have ruined man's chances of preserving the environment. The novel exposes the significance of living in perfect harmony with nature, thereby defining the ecomasculine self that proves that it could care for the environment. Exploitative forces are too strong for the protagonist who has to give up his life fighting against the onslaught of modernity. The paper critiques man's callous attitude to nature and simultaneously warns mankind of impending danger of total annihilation of mankind due to ecological imbalance.

Keyword: Ecomasculinity, ecology, nature, culture, power.

"Neither ecocriticism, nor men's studies, nor queer ecologies, nor (to date) ecofeminism has offered a theoretical sophisticated foray into the potentials for eco-masculinities" (Gaard 12).

As proposed by Garrd, ecological masculinity is of immense significance because it establishes a crucial point of divergence from traditional masculinity that maintains a dominant and the dominated relationship with nature. Knowledge, material success, power and rationality are the probable parameters that are considered when discourses on masculinity are taken into consideration because masculinity rests on the assumptions based on these factors in relation to politics, society and economy. Ecological masculinity would be part of remaking the economy and facilitating the transition towards a more environmentally benign way of living with the ecosystems in the biosphere. This way, ecomasculinity would ensure the sustenance of the environment in the face of technological advancements and the indiscriminate use resources to serve man's needs.

This paper analyses how the shades of masculinity with regard to nature are enacted by the characters in Edward Abbey's *Fire on the Mountain* that would subvert the traditional masculine positions that rest on maintain a rigid contact with the word, based on control and power. The novel delineates the conflict between the old rancher and nature- conservationist John Vogelin and the United States government that tries to take the possession of the ranch in order to extend the missile range for the United States Airforce. Vogelin's resistance to give up his farm for nuclear purposes and his final defeat in the course of the events evinces the need to understand the values and practices of men that could formulate and decide about the environment without subjugating nature for personal gains. The protagonist disapproves of man's callous attitude to nature and simultaneously warns mankind of the impending danger of total annihilation of mankind due to ecological imbalance.

Traditionally, in the West, the relationship between man and nature is based on power, control and conquest. The fictionalized lives of cowboys and pioneers proved their masculinity by subduing nature to their will and by exploring, penetrating and conquering the 'virgin land'.

The ecologist Martin Hultman defines this attitude to nature similar to Industrial masculinity, which is "a figuration that evaluates nature as dead, man as the chosen dominator, and engineering as the method of creating wealth for all humans"("Green Men?" 4). Industrial masculinists believe that the world is dead from the beginning and primarily exists for humans to conquer and extract resources from. Ideas from engineering and classical or neo-classical economics, favouring large-scale and

centralised energy technologies and the practice of patriarchy are contained in the practice of industrial masculinity. Projects that range from large- scale hydropower or nuclear power plants to fossil fuel technologies are projections of this masculinity (Ohman 56). In relation to nature, the most important idea is to separate it from humans and value it as a resource for human extraction.

Historically, industrial masculinity was challenged in the 1970s by "ecological masculinity …which gained presence at this period in history as well as previous research on masculinity which has used this term" (Gaard 32). This form of masculinity has a history that spans many years and has taken shapes as the Earth God Kokopelli in New Mexico (33) or later in the history the Green Man (Basford 54). The Green Man, found in variations in many cultures throughout the world, is a figure that could be seen in Europe in cathedral carved heads from the twelfth to the sixteenth centuries. The figures manifest a heterogeneous variety of features, but the Green Man is often a face or head sprouting, surrounded by, or even entirely made from, leaves and foliage. He is found carved in wood or stone usually interpreted as a symbol showing the cycle of birth and death (55). This is a legendary figure that features in the annals of time.

In the 1960s, ecological masculinity emerged in retaliation to industrial masculinity. Localization of economies, use of technologies on a small scale basis, creation of renewable energy sources, decentralization of power structures as well as living harmoniously with nature, the flora and the fauna are regarded as the everyday practices that enact ecological masculinity (Hultman 75). Such an approach could not be regarded as effeminate because it calls for an approach that would care for the environment by maintaining a symbiotic relationship that would cater to the preservation of the entire species on earth without being too passionate or emotional, but centered on finding a solution that would resolve the environmental crisis forever.

The green wave in the 1980s not only suggested the recycling of old technologies and old values, but also created a vision of eco-socialist-based intentional communities of alternative modernity. These groups created alternative projects amidst the dominant model. Their models and experiments were part of "a mighty international peak in environmental consciousness" in the 1980s (Hultman 76). Primarily antagonistic to industrial masculinity, during this period, a form of masculinity exemplified being caring, humble and sharing sort was presented as being more appropriate in an ecologically sound society and challenged the hegemony of what has been called cowboy, industrial, or hegemonic masculinity(*Masculinities* 125).

Ecomodern masculinity recognises environmental issues as an intrinsic part of politics from the 1990s onwards. It can be defined as "an assymetric combination of the determination and hardness of industrial modernity with appropriate moments of compassion and even sense of care for a vulnerable environment from environmental movement" (Hultman "Transition" 78). Ecomodern masculinity is the dominant configuration of masculinity in recent years when handling several environmental issues. Ecocriticism gives human beings a better understanding of and a broader view of nature. It analyses the role played by the natural environment of the imagination of a cultural community. Cultural moorings form an inevitable part of any eco- critical discussion and depending on what man thinks about himself in relation to things around him, he acts and alters the ecology around him either positively or negatively. Representations on masculinity in fiction are wrought by social, economic and political reasons that seem to influence the divergent attitudes to human response to nature around them.

Fire on the Mountain presents the rigid modern world, set over two hundred miles South of Duke City, New Mexico. It appraises the western code of behavior to explore the individual's role in the larger scheme of the voracious society and takes on the entire United States government in conflict with the individual. John Vogelin is an old rancher whose property adjoins the White Sands Missile Range in New Mexico. When the United Air Force tries to take the possession of the ranch in order to extend the missile range, the old man refuses to give up his property. Aided only by his twelve-year-old grandson, Vogelin shows what one determined individual can do in the face of overwhelming legal and military power.

The novel begins with the description of Mexico as: "Brightest new Mexico. In that vivid light each rock and tree and cloud and mountain existed with a kind of force and clarity that seemed not natural but super natural" (*Fire* 1). Then, Vogelin's grandson Billy takes up the theme "yet it also felt as familiar as home, the country of dreams, the land I had known from the beginning" (1). The reader is transported to that twilight zone of an imagined new

Mexico on highway of heat waves, "giving the road far ahead a transparent, liquid look, an illusion which receded before us as fast as we approach" (1). The landscape feels like "Paradise" (1) to Billy who is fascinated by the natural beauty of the countryside. The land is both the philosophical and the emotional crux of the story is but a reflection of the author's depiction of the landscape.

John Vogelin has not changed or evolved with modernity. John's life is inextricably and harmoniously blended with nature. Billy, in the first person narrative, records many nostalgic moments of his boyhood days spent with John. Being close to nature for a long time, he expounds the crucial and inevitable bond between various objects in nature and the individual. John is deeply related to nature and he even derives his philosophy from nature. He is neither a romantic nor an idyllic that writes or recites verses, but a practical environmentalist who recognizes the role played by each species of the ecosystem. He knows that each organism has its role in the ecosystem. For instance, John dwells upon the role played by rabbits and vultures that help "preserve the balance of nature" (*Fire* 3). This illustration proves that each species "performs unique and specialized functions which play a part on the overall stability of the community" (Meeker 162). The ecomasculine individual understands the interconnectedness of each system in the environment and seeks to preserve the delicate balance in nature.

John's descriptions of the behavior of animals and birds are accurate. He notices the complicated and sophisticated patterns of behaviour of the creatures in his ranch and explains the roles of each animal in maintaining the balance in the ecosystem. John describes the road-runner, who s is stubborn and runs in absolute speed. He explains how the road runner is different from the jack rabbit that ends its life running along with vehicles and dying during the chase. Billy loves the land as much as his grandfather and would stay to death with him if he could. He says: "Sir, if you'll let me, I won't go back. I'll never go back. I'll stay here and work for you for the rest of my life" (*Fire*12). Billy's desire to take care of the land is grounded in the ecological principle of maintaining intimate contact with all things of the biosphere disregarding the monetary or material gains out of the connection.

John hates the persecution of animals in the name of progress. He shows a selfless concern for the world and the flora and fauna around him. Talking about the tallow balls used to kill the wild animals by the fellows of the National Fish and Wildlife Services, he says that the poison used to kill animals in the name of progress is detrimental to the survival of the species on earth. He questions the rationale behind killing animals and destroying their habitats in the name of progress: "Progress. I say, Let's turn back the clock. Why does progress have to progress over me and the coyotes?"(*Fire* 32). In such a view of the ecosystem, there is no trace of the anthropocentric arrogance or a dominating attitude towards nature. John is an ecomasculinist who believes in the oneness of creation and suggests a mode of progress that does not take advantage of nature. Man becomes here a part of nature, not its exploiter.

Billy's ride with his grandfather exposes man's cruel side that reduces the role of nature to a provider, to be used and discarded. Man is predatory by nature and through his quality has made the entire planet his prey. The persistent question is the cruelty of man towards the other forms of life on earth. While searching for the horse, Rascal Lee gives graphic details of this cruelty in claiming the coyote he has killed to be his property. Man believes that no other species is more important than him. John says: All beliefs are provisional, subject to change when they fail to produce harmonious consequences" (*Fire*167). It is man's responsibility to realize the importance of preserving the various groups of plants and animals that exist on earth. When Billy asks John whether they would hunt a lion, John says that is futile to kill an animal for no reason. He adds: "Besides, it's the only lion left on the place. I can't afford to lose him" (59). Billy likens his grandfather to the lion that is "aged, battered but still mighty lion" (61).

John exhibits a wonderful sense of ecological wisdom as he and Billy walk towards the trail. Billy admires John's close association with nature when John predicts the arrival of rain in the area and the amount of water they would require. Living in close proximity with nature, John could not only make accurate judgements but also prove that nature has a cycle of its own that depends on man's treatment of the various species of the biosphere. Charmed by the beautiful sights and sounds of birds like night hawks, ravens, magpies and especially a trickling water song of a canyon wren, Billy asks: "Is heaven better than this place? John responds: "The climate's a little better here" (62).

The changing perceptions of masculinity over a considerable period of time propose masculinity to be a dynamic concept that undergoes

nuanced meanings. There is a pointed focus on place and time in the novel which lends itself to ecocritical analysis. Such a reading accentuates a homogeneous world where man shares an equivalent relationship with the vegetation and other life forms. To John, his life covers the entire ecosphere where all the things he sees around him are connected to the other as a chain. It also represents a culture that lives in tune with nature and it is in this culture that man's roots lie.

At this point of time, "civilization" encroaches upon John's property when the government wants his isolated ranch for a guided-missile test site. John refuses to sell the ranch and vows to resist the demands at any cost. He never agrees to vacate the premises. In the opinion of the government, the ranch is a plot of mud and land meant to be explored for nuclear purposes. The government represents the attitude of the industrial masculinist that uses natural resources to the advantage of a few. It disregards the need to preserve nature since nature is a source of economic progress. In its view, the separation of man from nature would be ideal because nature is seen as an inexhaustible resource for human extraction and progress. Nature is sacrificed in the name of progress and material comfort.

While John's neighbors gradually succumb to pressure and leave the area, he grows more uncompromising and aggressive. If necessary, he would fight single-handedly to protect his property from the government so that he can protect the area from being destroyed by nuclear power. Lee, John's friend asks him to vacate the place because the government is too powerful for them: "Nobody is safe when the government can take away his home" (142). John is unwilling to leave his ranch. He replies:

This is my home. I was born here. My father worked and fought all his life for this place. He died here. My mother died here. My wife almost died here. Now I want to die here, when I am ready to die. I will not leave here part time as some sort of charity ward of the government while they think up new ways to wedge me of completely. No, by God, I can't do that. I'll fight it out with bullets before I'll do that. (142)

John's courage to defy the orders of the government signifies the arrival of the green movement that promoted the protection of the environment. John is one among the many others who would not tolerate annihilation of the ecosystem. They are against androcentrism and they are ready to spread the message of an ecocentric approach to maintain global harmony.

After the Air Force rounds up John's cattle, sells them and drives away his hired man and family, it aims for John too, but the seventy-year-old rancher restricts the entry of the troops at gunpoint. When his best friend Lee Mackie betrays him, John is defeated. Forced to leave his land, he retreats to Alamogordo and lives in isolation, grieving the inevitable death of the inmates of the ranch. After a few unhappy nights, John sneaks back to the mountains above his ranch and dies; a victim of an apparent heart failure. Giving a Viking burial, Billy and Lee watch John as he "disappeared within the fire, wrapped from head to foot in flame, and cell by cell, atom by atom, he rejoined the elements of earth and sky" (180). His grandson and Lee have given him a burial, which is a symbolic fire in the mountain while the United States marshal looks on. Lee mentions that the old man has now become one with nature, a gesture that proclaims John's irreconcilable temperament in resisting destruction of the environment because he sees life in every object living or non-living, on the ranch.

According to Manes: "In addition to human language, there is also the language of birds, the wind, the earthworms, wolves and waterfalls -a world of autonomous speakers whose intents (especially for gatherer-peoples) one ignores at one's peril" (15). The concluding line of "Fire on the Mountain" declares a similar proposition: "Far above the on the mountain side, posed on his lookout point, troubled by the fire, the lion screamed" (181). The death of John is a warning against the birth of destructive forces that would soon devastate the ranch resulting in the death of divergent species in the area. John's demise foregrounds the power of destructive forces that are resolved to inflict damage to the existing fragile balance of the ecosystem.

John's attempts to protect the ranch from the government are an individual's effort to restore peace and harmony in one's habitat. The novel proves that a single man's need to conserve the biotic and abiotic elements is in vain and the ecomasculine projection of the individual is at the losing end. However, the issue could be resolved if forces could join hands to prevent the onslaught. This would mean that joint endeavours could subvert hegemonic masculinity and create potentially new, mutually enriching and non-oppressive conversations between man and nature. In the desire to conserve the environment, man

should be wary of the resurfacing of hegemonic control of the surroundings. Rather than provide a discourse of oppressiveness, one could locate interconnections between oppressions and thereby argue for interdependent oppositional politics. It would be wise to restrain from feminising or romanticising nature, which historically have been indicative of dominating or repressed relations to nature and women. The transition towards a more environmentally conscious way of asserting oneself is to be practiced.

Abbey creates a counter- discourse to the traditional rhetoric of masculine practices and self-affirmation through the exploitation of nature by depicting John to be a man who believes in peaceful co-existence with nature. John loses because of the United States government's superior strength but the book succeeds in a crucial way. It projects the culture of New Mexico that witnesses the continuous struggle between the ecomasculine phase and the industrial masculine phase. The seeds of economic strength and power sown at the expense of nature are witness to the uncompromising struggle in the modern era, the conflict between industrialization and preservation of nature in the face of progress and scientific advancements. The novel presents an experience of nature which is emotional as well as capable of tempering the mind with simple human love for all living things, thereby associating one with nature.

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NATIVE, NATURE AND NEGOTIATION: AN ECO-LITERAL STUDY OF CONCILIATION OF PAST AND PRESENT WITH REFERENCE TO LESLIE SILKO'S NATIVE AMERICAN FICTION *GARDENS IN THE DUNES*

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ABSTRACT

The indigenous cultures all over the world are strongly interwoven with a range of natural components. All these indigenous and aboriginal worlds including Native Americans are known for their holistic tradition as they love and revere a variety of ecological elements such as the Mother Earth, foliage, waterway, deep marine, and downpour. In the Native American fiction *Gardens in the Dunes* by Leslie Marmon Silko, the author weaves a spectacular narrative to convey the story of nature, home, mother, memory, exile, and return. Silko portrays this strong bonding while depicting the close relationship between Nature and various Native American characters. As the Native American culture believes in the deep bonding between its nature and its community members, their varied forms of farming and gardening become integral to their cultural identity. The recurrent recollections of Indigo's mother, her Grandmother Fleet, Sister Salt, and above all, the image of the Old Garden represent the recreation and reconstruction of her cultural memory and its association with the Mother Nature. The protagonist Indigo's love for gardens brings back the mythical memory of the Biblical 'Garden of Eden' which is the 'Garden of God' as described in the Book of the Genesis. The displacement of Indigo from her indigenous garden becomes a representation of the man's dissociation from nature and Indigo's homecoming to her native garden denotes man's perpetual longing to reconcile with Mother Earth. Thus, this paper seeks to analyze the re-establishment of a negotiation between old and new, past and present and most importantly the man and the nature in the backdrop of colonization with reference to *Gardens in the Dunes* by Leslie Marmon Silko.

Keywords: Nature, Indigenous, Mother Earth, Nativity, Ecology**.**

"We are either going to have a future where women lead the way to make peace with the Earth or we are not going to have a human future at all."

-Vandana Shiva

The indigenous cultures all over the world are strongly interwoven with an assortment of pagan components where the aboriginal populaces including Native Americans are known for their holistic tradition as they love and revere a variety of ecological elements. As the Native American culture believes in the profound union between nature and its community members, their varied forms of farming and gardening become integral to their cultural identities. Leslie Marmon Silko, the Laguna Pueblo author, poet, storyteller is known for her signature storytelling style and for using it as a mode of resistance against the imperial cultural hegemony. Along with other postcolonial artists, historians, and philosophers, writers Silko tend to share immense responsibility for the cultural memory systems of their communities while focusing on the prominence of nature in the lives of Native Americans. In her postcolonial fiction *Gardens in the Dunes* (henceforth GD), Silko weaves a spectacular narrative to convey the story of nature, home, mother, exile, displacement, memory and homecoming. The recurrent recollections of the protagonist Indigo, her mother, Grandmother Fleet, Sister Salt, and above all, the image of the Old Garden represent the recreation and reconstruction of her cultural memory and its alliance with the Mother Nature. The protagonist Indigo's love for gardens brings back the mythological reminiscence of the Biblical 'Garden of Eden' as the 'Garden of God' as depicted in the Book of the Genesis. The displacement of Indigo from her indigenous garden becomes a representation of the man's dissociation from nature and Indigo's homecoming to her native garden denotes man's perpetual longing to reconcile with Mother Earth. Thus, this paper seeks to analyze the re-establishment of a negotiation between old and new, past and present and most importantly the man and the nature in the backdrop of colonization with reference to *Gardens in the Dunes*.

In the afore-mentioned text, the storyteller acts as a historian as she discusses the political, historical events of her time along with the telling of the tale of the Native American girl Indigo. The text

revolves around three women, the Native American Indigo, her Sister Salt and Indigo's White guardian Hattie, their perpetual longing for their roots in the backdrop of 20th century. The fiction covers a range of geographical landscape starting from Southwest America to England, Brazil, Italy, Long Island, and the Corsica Island. Indigo, a girl of around eleven, and her family happen to be one of the last few survivors of the imaginary Sand Lizard people, who have been gardening and cultivating in the invented riverbed of Colorado for a long time. Being "driven from their homelands to exile on federal reservations in the United States" (Willard 140) young Indigo is separated from her mother, Sister Salt, and Grandmother Fleet, forcefully taken to a boarding school, and finally takes shelter in the garden of a white couple Edward and Hattie. Meanwhile, in the road trip to Europe, Indigo is exposed to a completely new world of white people, and beautiful Victorian gardens. When Edward gets killed by one of his partners and Hattie chooses to stay with her aunty in England and Indigo comes back to her old garden to be reunited with Sister Salt.

The text opens with a visually rich scene of two Native sisters playing in the rain. As Silko describes, "The rain smelled heavenly. All over the sand dunes, datura blossoms round and white as moons breathed their fragrance of magic" (GD 13). By creating a sensory imagery in the opening sentence of the text, Silko succeeds in taking the reader 'down the memory lane' when things were different from the contemporary times, thus regulating the reader to a Native-American landscape sans the colonial experience. Being significantly influenced by Native myths, the history of gardening, and her contemporary political set-up, Silko takes up the themes of redressal and affirmation in the text. As a note to her afore-mentioned text, Silko confesses that,

Seed catalogs and garden books are favorites of mine … Nearly all human cultures plant gardens, and the garden itself has ancient religious connections. For a long time, I've been interested in pre-Christian European beliefs, and the pagan devotions to sacred groves of tress and sacred springs. My German translator gave me a fascinating book on the archeology of Old Europe, and in it I discovered ancient artifacts that showed that the Old European cultures once revered snakes, just as we Pueblo Indian people still do. So I decided to take all these elements- orchids, gladiolus, ancient gardens, Victorian gardens, Native American gardens, Old European figures of Snake-bird Goddesses- and write a novel about two young sisters at the turn of the century (Silko, Author Note, 480).

Silko's fascination for gardens establishes her close association with Nature, as a Native American. Like Silko, Indigo is lost when she comes across the pictures of the beautiful gardens of Europe. Silko asserts that "Indigo lost interest in the costumes when she saw the pictures and diagrams of Renaissance gardens; she spent the rest of the afternoon in the library, kneeling on a chair while Hattie browsed the shelves for other books of gardens and architecture" (*GD* 177). Indigo's love for garden evokes her close rapport and connection with nature.

Likewise, the Native American way of farming has its own distinct repute. As the Native American culture believes in the bonding between its community members, it also applies the same to its form of gardening and farming. Indigo's love for gardens brings back the mythical memory of the Biblical 'Garden of Eden' which is the 'Garden of God' as described in the *Book of the Genesis*. As the image of Eden Garden is generally associated with the mythology of Adam and Eve, this garden also symbolizes love, passion, and sexuality. There are different kinds of gardens shown in the text. These gardens belong to different culture, different lifestyles, and different timelines. There is the Native garden of Grandmother Fleet and Indigo, the Victorian garden of Mr. Abbott, Hattie' father, and the aesthetically decorative garden of Susan, Edward's sister. These gardens are also representative of different kinds of sensibility as the motives behind cultivating a garden differs from each other. If for Grandmother Fleet and Indigo, cultivating garden is a way of life, for Mr. Abbott, it is a sense of possession and for Susan, cultivating a garden boosts her sense of aesthetic satisfaction. Similarly, cultivation of seeds too differs from each other in case of every garden. Where Indigo's Native garden is used for cultivating grains and wild flowers, the garden of Mr. Abbott and Susan are more about cultivating flowers. It comes as a sharp contrast because in the sand desert where Indigo lives, it is infeasible to waste water on sophisticated flowers. However at the end of the text, Indigo comes back with seeds from Europe which she cultivates in her garden. This act of Indigo can be seen as a means for survival and continuity irrespective of the conflicting geo-political circumstances at home. It also spells the Native American sense of humility and acceptance of perspectives other than theirs.

Apart from providing a meaning to the lifestyle of the characters, the gardens in the text also give a mythical interpretation to its existence. The Garden of Eden is also synonymous with paradise and dislocation from Eden can be considered as being banished from the paradise as it happens in the case of Adam and Eve. Simultaneously, it can also refer to the Native people's idyllic existence in their 'gardens' before the colonial forces intruded and corrupted it forever. Moreover, the lovemaking between Edwards's sister Susan and her Scottish gardener in Susan's garden can be referred as a focal point for considering garden as a symbol of passion and sexuality. As Indigo wanders through the garden of Susan, she catches Susan and her gardener being together. As Indigo watches on,

Susan picked a lily of the valley and gave it to the gardener, who did a most amazing thing: he kissed Susan on the lips. Indigo took a deep breath as her heart beat faster. She knew Colin was Susan's husband, not the gardener, and she knew the laws of white people; men and women don't touch unless they are husband and wife. That's what the dormitory matrons and boarding school teachers emphasized again and again; girls stay out of one another's beds, and the boys too (*GD* 191).

As Indigo remembers the things she was taught in the boarding school about white man and woman and their relationship, the irony of the action of Susan and her gardener comes as a critique on western culture and its so-called importance on Christian values like virtue and chastity. Silko, in a tongue-in-cheek manner, criticizes the biased and partial education being imparted to the Native American children in the boarding schools. Since colonization, the concept of centre and periphery remains in the background-associating the Natives with physicality and the Europeans with intellect. But such long-held norms and clichés are parodied in the text as the Native girl Indigo witnesses the sexual liberties taken by the liberal minded European Susan. Likewise, the lovemaking between Susan and her Scottish gardener comes as a contrast to the Victorian Christian belief on the institution of marriage. The indigenous Indigo, however, looks at it from an aesthetic perspective where she imagines both of them as beautiful marble statues in the garden. Having inherited the Native aesthetic sense of body, Indigo purely believes in physical pleasure. As Silko goes on describing the emotions of Indigo, she writes,

Indigo was fascinated and wanted to see as much as she could. No wonder Susan wanted the English gardens with all the shady shrubs and groves of sheltering trees where two lovers might hide … She was surprised how bright white their nude bodies appeared; if they had not been wiggling and bouncing around so much, they might be mistaken for marble figures taken down by the workmen. So the marble figures served a purpose after all: who would notice two more reclining among so many other nude figures in the gardens? (*GD* 191).

Indigo's fascination and appreciation for European artifacts gets a new meaning after she encounters Susan and her gardener lover in the former's English garden. Similarly, for the Native Americans, the garden is synonymous with paradise along with the snake-guardian. Dislocation from their paradise has created a traumatic memory for the Native American collective psyche. Contrary to the popular Christian belief, in Indigo's paradise, the rattlesnake is a guardian unlike the Satan in the Garden of Eden. Both Indigo and Hattie fall for gardens as they both are deeply influenced by their respective cultural traditions. Indigo is moved by her Native culture and Hattie is more interested in the early Christianity which is somewhat pagan by nature. As Silko describes the love of Indigo and Hattie for gardens, she writes as follows,

Indigo lingered over books with pictures of gardens with water splashing from fountains and statues and even a long stone wall covered with spouts of gushing water. Hattie pointed out what appeared to be extensive stone stairs built for a great cascade of water to a long pool below … They looked at the books together and Hattie pointed out the French gardens and Italian gardens, but Indigo did not see a great deal of difference between them-except the French gardens seemed so empty while the Italian gardens were populated with stone figures of animals and people (*GD* 178).

The fact that European culture was once upon a time based on Paganism is reaffirmed through Hattie's character. Hattie almost becomes a western parallel of the indigenous Indigo. Silko through Hattie tries to bring about reconciliation and harmony between two seemingly disparate cultures. The garden of the Native Americans also symbolizes Mother Earth or Mother Nature that celebrate fertility and prosperity. Here, the feminine image represents the figure of Mother Earth which points to goddess worshiping in Native American and Pre-Christian traditions. Such a scenario also brings forth the concept of a matriarchal society which can be

identified, specifically, with the Native American traditions. For Native Americans, Mother Earth is the source of their life on whom they are significantly dependent. Interestingly, much like ancient Indian tradition where one can find powerful female imageries such as *Durga* and *Kali*, Native Americans too believe in images of feminity which would bless them forever.

In the text, Indigo's garden is protected by the niece of the Snake-goddess a popular mythical figure from Mesoamerican mythology, as 'Quetzalcoatl' or the 'Feathered Serpent.' As Silko puts it beautifully,

Early the other morning when she came alone to wash at the spring, a big rattlesnake was drinking at the pool. The snake dipped her mouth daintily into the water, and her throat moved with such delicacy as she swallowed. She stopped drinking briefly to look at Sister, then turned back to the water; then she gracefully turned from the pool across the white sand to a nook of bright shade. Old Snake's beautiful daughter moved back home (*GD* 477).

The Snake-Goddess is also featured in the Native American Maya traditions, where it is known as 'Kukulcan' or 'Gukumatz.' Interestingly, the figure of 'Feathered Serpent' in Native American traditions symbolizes cultivation, fertility and the renewal of vegetation. Along with the images of the gardens and Mother Earth, Silko explores the image of the Messiah as well as she has previously done in *Almanac of the Dead*. Both sister Salt and Indigo are closely related to their gardens. Being close to nature, the lives of these two sisters are constructed with relation to their love for gardens- gardens that symbolize Nature and Mother Earth in the text. Silko describes it thus: "After the rains, they tended the plants that sprouted out of the deep sand; they each had plants they cared for as if the plants were babies" (*GD* 14). The relationship that Native Americans share with their gardens goes back to very old times. They inherit their gardens as they inherit their cultural values and traditional stories. Indigo remembers-

Grandma Fleet told them the old garden had always been there. The old time people found the gardens already growing, planted by the Sand Lizard, a relative of Grandfather Snake, who invited her niece to settle there and cultivate her seed (*GD* 14-15).

It is interesting to note that while the mythical story of the Sand Lizard brings back lost memories and folk tales, the image of the snake guardian is Native American as well as European. In fact, this image is also found in other Native cultures such as the Indian and the African. Indigo's garden also nurtures a rattlesnake which supposedly protects this indigenous family. In the climax, the reader comes to know that the white people who come to the old garden in search of the Sand Lizard people kill this rattlesnake. But then, the old dead snake is replaced by a new and beautiful snake that comes back to the garden when Salt and Indigo come back to their home. Here, the return of the rattlesnake and the return of the two sisters is parallel as both of them come back with their own stories of struggle and survival. Their stories are connected and they are the mirror images of each other, symbolizing the exploitation of nature and its revitalization. Silko confesses to Thomas Irmer that:

When I wrote Ceremony I realized that this old story is still very relevant, even now, even though these old stories take place in the past they have meaning now. Oral literatures of the indigenous populations worldwide contain these kinds of valuable insights. When Sigmund Freud wrote his Interpretation of Dreams, he began to respect folklore. You can look at the old stories that were told among the tribal people here in a north country and see that within them is the same kind of valuable lessons about human behavior and that we need them still (Silko, Irmer, 1).

When the memories of Sand Lizard culture keeps on emerging in the mind of young Indigo, her identity of her Native self keeps shifting. Her exposure to her own ancient tradition as well as Victorian Christianity creates a double consciousness that results in hybridizing the identity of her Native self. Therefore, the ever-shifting sense of communal identity of Indigo, and Salt, for that matter is highlighted by Silko throughout the text. When towards the end, Hattie chooses to stay in England with her aunt after the death of her husband Edward, Indigo comes back to her old garden to be reunited with Sister Salt.

Indigo's homecoming not only with the new knowledge imparted by white people but also with black glasiolus corns and contraband orchids and her cultivation of these European seeds in her Native garden symbolize the path of mediation she desires to adopt. The intermingling of Nativity and Modernity results in an assimilation of which Indigo happens to be a postcolonial product. The mixed-blood identity of the Native Americans here is thus put into negotiation where they counter-narrate the legacy of

colonial exploitation but concurrently keep hold of their primitive bonding with Mother Nature, integral to their cultural identities.

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ENERGY MANAGEMENT IN COMMERCIAL FOOD SERVICE OPERATIONS

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ABSTRACT

Asia has experienced the world's fastest economic growth, accompanied by rapid urbanisation. This remarkable growth has led to twin energy challenges namely sustainability and energy security and this study explores the possible energy conservation methods in the selected food service operations and hence the study was undertaken with objectives to study the different types of energy used in selected food service operations, assess the renewable and non renewable resources used in various sections of the food service operations and develop the various energy conservation methods adopted at food service operations. A total of five food service operations with three commercial and two non- commercial food service operations at Coimbatore were selected for the study. An energy audit programme was conducted for three sessions at each food service to understand the existing pattern in energy management using a checklist. Based on the results of the energy audit, the guidelines were planned and implemented for two days at each food service operation using flash cards, power point presentation and face to face to discussions. A total of forty employees with eight from each food service operations were deputed to participate in the programme. The energy management programmes planned and implemented to the selected Commercial Food Service Operations and Non Commercial Food Service Operations when interpreted with statistical 't' test a significant improvement at five percent levels both at the selected Commercial Food Service Operations and Non Commercial Food Service Operations.

Keywords: Conservation, efficiency, management.

1. INTRODUCTION

Energy Management in food service operations is the practice of controlling procedures, operations and equipment that contribute to the energy use comprising electricity, gas, water and other natural resources. The common sources of energies are non-renewable, such as all fossil fuels (coal, petroleum and natural gas) are formed millions of years ago and cannot be reproduced and they emit carbon di oxide when burned.

The sources of energy which have accumulated in nature over a very long time and cannot be quickly replaced when exhausted are termed as non-renewable source of energy. The renewable source of energy are the alternative form of energy which can save us from the energy crisis and become the major source of energy in the future (Prabhakar, 2001).

Waste to Energy (WtE) conversion is a approach to resolve two issues including waste management and sustainable energy. Waste represents an increasingly important fuel source. Using waste as fuel can have important environmental benefits. It can not only provide a safe and cost ineffective way of waste disposal but can also help reduce carbon-di-oxide emission (Bose, 2009).

"Energy Management in Selected Commercial Food Service Operations" was undertaken with the objective to study the different types of energy used in selected food service operations, asses renewable and non renewable resources used in various sections of the food service operations, to develop the various energy conservation methods of food service operations.

2. METHODOLOGY

A total of five food service operations with three commercial food service operations were selected on judgement sampling . The sample was selected using judgement sampling In judgement sampling, the judgement or opinion of same experts forms the basis of the sampling method. it is expected that these samples would be better as the experts are supposed to know the population (Bhattacharyya, 2009). Energy audit programme was carried out for three days to observe the efficiency of fuel utilisation and the steps followed for energy conservation using a checklist. Imparting

guidelines for efficient energy management was based on the results of the energy audit.

The guidelines were planned and Implemented for two days at each food service operation using flash cards, power point presentation and face to face to discussions. A total of forty employees with eight from each food service operations were deputed to participate in the programme. Evaluation on energy management in selected food service operations was done with the estimation of improvement was done with the help of checklist for post observation. The impact of the energy management programmes was statistically analysed to find the levels of significance using 't' test.

3. RESULTS AND DISCUSSION

3.1. Findings of the study

The findings of the study on energy management in commercial and non commercial food service operations is discussed.

3.2. Energy consumption

As energy consumed is directly proportional to the area of the operation. Larger the area higher is the energy consumption and it calls for more number of equipment especially for lighting and ventilation. Hotels consume more energy when compared with other non commercial food service operations.The commercial food service operations including hotels that provide lodging and boarding, was observed full occupancy of 75 per cent on all the days

3.3. Kinds of cuisines served in the food service operations

The fuel consumption and the cooking time of each cuisine different. South Indian cuisine needs more time followed by north Indian in par with the time for Chinese cuisine.

3.4. Type of energy used and consumption per day in food service operations

The type of energy used states that there was increased energy consumption in commercial when compared to non commercial food service operations

3.5. Transition of fuels

There was a transition of fuels seen in hotels because of Increase in cost, easiness to use the energy sources were the reasons reported for the transition of fuels by the selected food service operation.

There was more usage of non renewable than renewable resources. The renewable sources used mostly consisted of biomass which also releases carbon-di-oxide. So clean energy options were given such as solar, wind and hydro power.

3.6. Details of employers in the food service operations

Energy conservation is the responsibility of each and every employee and mainly for the employees working in industries. The larger the number of employees, there are more chances of overlooking. Food service industry is a fast growing industry and now it needs to watch out on its fuel consumption. To check and to control any situation, man power is the major resource, therefore employees play a major role in controlling energy wastage.

The energy management programmes planned and implemented to the selected Commercial Food Service Operations when interpreted with statistical t' test a significant improvement at five percent levels both at the selected Commercial Food Service Operations

4. CONCLUSION

Energy Management practices adopted by the food service operation showed that the awareness existed among the management and the employees of the selected Commercial Food Service Operations in the use of energy saving equipments such as vegetable cutter, mixer grinder, potato peeler and lacunae was noticed in the utilization of energy in different section of food service operation. Hence more number of training programmes has to be planned and implemented at regular intervals for adoption of eco-friendly and energy management practices. The energy conservation practices in customer centric business practice will help to fight the energy crises and save the energy and environment for the future generation.

SAVE ENERGY, SAVE ENVIRONMENT

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NATURE AND SOCIETY AS REFLECTED IN ACHEBE'S THINGS FALL APART

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ABSTRACT

The aim of this paper is to attempt a reading of *Things Fall Apart* from an eco-critical perspective to show that Achebe was writing the novel in part to make his African readers aware of the extent of the embeddedness of their forefathers in the environment. To illustrate the ways through which he delineates the manifold connections between the African and the land. Achebe intends to focus on his depiction of the damage caused in the relationship between Africans and their natural world by the advent of colonization. Finally, through this paper hope to emphasize Achebe's profound belief in the importance of the connections Africans must reactivate with nature to make themselves whole again.

Keywords: Chinua Achebe, Ecocriticism, Things Fall Apart.

Eco-criticism has been glossed as "the study of the relationship between literature and the physical environment" Eco-criticism as something that "implies the long-term imbrication of humans in a landscape of ancestry, and death, of ritual, life and work" (108)1 Dwelling, for Gerard, involves the nexus between the lived life of a community and its rituals, between the human and the inhuman, between nature and culture. In building dwellings, a community roots itself in the physical world, and that world becomes a locus of memory and desire, till the land takes on a "figural" as well as a "literal" value (115).

Things Fall Apart is to represent the intimate relations West Africans had with the natural world before things started to "fall apart" from them as a consequence of colonization. What is distinctive about the novel is the manner in which it shows the close links between the Igbo people and their physical environment.

Things Fall Apart is not only the story of Okonkwo, a headstrong and proud man who is forced to commit suicide after being humiliated by the white men, it is also the story of the African community of Umuofia to which he belongs and its changing fortunes because of the coming of Europeans. What one notices about the first two-thirds of the novel is how Okonkwo's story is embedded in that of his community. It is interesting to read that Okonkwo's father Unoka lived in perfect harmony with his people and the land, while Oknokwo himself had a troubled relationship with it. In the eyes of the son Unoka is a failure, but we come to like him despite his son's complexes about his father, because "he loved the season of the year, when the rains had stopped and the sun rose every morning with dazzling beauty" (Achebe, Things, 4). For sure, he and the villagers are also aware of the darker aspects of nature, but they have learned to balance apprehension of dark nights with enjoyment of moonlit ones, knowing what to avoid and what to take pleasure in. They key to survival was to realize as the clan does when the rainy season overwhelms them that "nature was not interfered with" (31).

Unoka's death is indicative of the balance and good sense the community has achieved in rooting itself in the land, for when he is afflicted by a swelling of his body parts, the people of the village take him to the Evil Forest and leave him to die in isolation, no doubt because it knew that someone with contagious diseases such as small pox or leprosy or a virulent infection was best isolated from others. People who respected the earth and satisfied its yearnings. This is why when the characteristically intemperate Okonkwo beats up his wife, Ezeani, the priest of the earth goddess, Ani, rebukes him saying, "Our forefathers ordained that before we plant any crops in the earth we should observe a week in which a man does not say a harsh word to his neighbor as: "We live in peace with our fellows to honour our great goddess of the earth without whose blessing our crops will not grow" (28). But even Okonkwo knows that the earth goddess had to be appeased since she was "the source of all fertility" (33). That is why he mostly succeeds in life and ends up becoming a powerful and rich member of the community despite starting as a simple sharecropper. It is only when he exceeds the limits set on men, as when he kills the boy Ikemefuna with

his own hands needlessly although the child was in his care that he is criticized by members of his community for doing something unnatural.

In the second part of Things Fall Apart, Okonkwo is exiled from Umuofia because he has accidentally killed a member of the community, but this is due to his bad luck or the workings of his chi or personal god than to a personal failing. Interestingly, fratricide too is seen as "a crime against the earth goddess" (113), accidental or not, and Okonkwo has to settle with his mother's clan in the village of Mbanta for seven years. Here again his capacity for hard work means that he will be eventually rewarded by the earth and he will be able to rebuild his life in the new community. It is during his period of exile in Mbanta that Okonkwo first hears of the coming of the white man on "an iron horse" (125), as ominous to the villagers as the locusts that periodically afflict the land. Soon the whites bring their religion and win over outcasts and people like Okonkwo's son Nwoye, who had been alienated from his father's harsh ways ever since the murder of Ikemefuna. Significantly, one of these outcasts kill "the most reverend animal in Mbanta and all the surrounding clans" (145) the python, and in doing so infuriates the Ibos, particularly Okonkwo.

Okonkwo before he returns to Umuofia at the end of seven years, he has found out that the white men's religion as well as government had spread over the land and converted many dissatisfied Igbo like Nwoye. The coming of the white man on an iron horse and the destruction of the royal python are symptomatic of the problems caused by the strangers. Although Mr. Brown, the first white missionary, seems conciliatory and preaches the form of Christianity appeals to mild-mannered men such as Nwoye, the Umuofians have split because of them and have become vulnerable. Part Two of the novel thus ends with one of the oldest members of the community talking about 'an abominable religion' that had divided the Igbos (152), causing some of them to abandon their people. He is fearful about Okonkwo's future and that of the clan; he can see the beginning of the end of their way of life.

Part Three of the novel finds Okoknwo back among his people in Umuofia, but it now contains a court house and a prison where the white men incarcerate anyone who offends them or transgresses their laws. As his friend Obierika tells him about the whites have "put a knife on the things that held us together and we have fallen apart" (160). Things become worse when the accommodating Mr. Brown is replaced by the aggressive Reverend James Smith. With his encouragement, Enoch, the turncoat slayer of the royal python, kills an ancestral spirit till "Umuofia is thrown into confusion" and the land seems to be full of "a strange and fearful sound" (168). The connections between the land and the community has come under severe strain and "the eerie voices of countless spirits" (169), disturbed and militant, raid Mr. Smith's church to flush out Enoch and then burn it. To the enraged Umuofians, the church and people like Mr. Smith and their lackeys among the converts had "bred untold abominations" (171). For the white invaders, the destruction of the church is the last straw. The white District Commissioner captures the Umuofian Okonkwo and the other men responsible for the attack and humiliates them. His court messengers then broadcast through the land his decision to release them only after a hefty fine had been paid by the clan for them.

Through a whole series of negative constructions Achebe portrays the dark and depressing shadow that has benighted the land, straining its people till they are on the verge of collapse: It was the time of the full moon. But that night the voice of children was not heard. The village ilo where they always gathered for a moon-play was empty. The women of Iguedo did not meet in the secret enclosure to learn a new dance to be displayed later to the village. Young men who were always abroad in the moonlight kept their huts that night. Their manly voices were not heard on the village paths as they went to visit their friends and lovers. Umuofia was like a startled animal with ears erect, sniffing the silent, ominous air and not knowing which way to run (176- 77). The sense of oneness with nature, the sense of a dwelling, of an environment where one feels at home is gone; the harmony and balance that sustained the community have disappeared; and the traumatized villagers have lost their sense of place and consequently have no sense of direction anymore. The villagers collect the money needed to release the captives. But when they meet again to decide on how best to drive the strangers out, court messengers appear on the scene to disrupt the meeting. It is at this point that Okonkwo slays one of them. Realizing that he would be hanged publicly for his action, Okonkwo kills himself, committing in the process the ultimate abomination, for a man who takes his own life, will therefore not be buried by his own people and would end up buried like a dog.

Things Fall Apart thus ends with the Umuofians traumatized, one of their standard

bearers destroyed, and the land itself degraded. And yet the novel had begun with a country where Ani, the earth, cared compassionately over the Igbos. Together with Agbala, the Oracle of the Hills and the Caves, and through their priests and priestesses, they had once upon a time ensured that mystic unity and eternal order over the universe. Though there were strains in the community these were contained in complex and manifold ways. But Achebe leaves us with no doubt that no matter how severe and proud a man Okonkwo was, and no matter how rigid the society in which he lived could be, the catalyst that destroys the fabric of the community and upsets the balance that sustained it is the coming of the white man. As the African critic Abiola Irele states it: Achebe's novels "deal with the social and psychological conflicts created by the incursion of the white man and his culture into the hitherto self-contained world of African society, and the disarray in the African consciousness that has followed" (80).

Achebe himself, as he put it in an interview, it is his belief that the European invasion resulted in Africans losing their "grip over history". It also led to their losing their memory of Africa, a massive loss since the past is all we have. That is why he had endeavored to tell the story of Okonkwo and Umuofia's destruction, for the story of their strengths and weaknesses must be told as effectively as possible if the people of Nigeria were to achieve some sort of balance again. To tell the story of the falling apart of the Umuofians, Achebe resorts to the storytelling techniques and traditions of his people. When in an interview with Charles H. Rowell, he is asked what he means by identifying himself as a storyteller, this is what he has to say: ..."we mustn't forget that we have a certain link of apostolic succession; if you like, to the old griots and storytellers and poets. It helps anyway; it gives me that sense of connectedness, of being part of things that are eternal like the rivers, the mountains, and the sky…"(Rowell, 269). This sense of connectedness and of being in the tradition of oral story-telling is most clearly manifested in Achebe's use of Igbo proverbs and his use of metaphors and similes that arise from the African story-teller's oneness with the physical environment.

In *Things Fall Apart*, the narrator signals the centrality of proverbs rooted in nature in the opening pages of his narrative when he tells us: "Among the Ibos the art of conversation is regarded very highly, and proverbs are the palm oil with Chinua Achebe's *Things Fall Apart* Eco-critically which words are eaten" (6). The story of Okonkwo's rise and fall and of his community's disintegration is thus strung with proverbs. For instance, Okonkwo on the rise is admired for his wily qualities which are said to make him "as slippery as a fish in water" (3). His physical prowess makes him highly visible in Umuofia where his fame is said to have grown "like a bush-fire in the harmattan" (ibid). He is accepted by the elders of the community, one of whom graciously accepts his present of kola nut and alligator pepper. The elder acknowledges his status and right to be himself by telling him, "Let the kite perch and let the egret perch too" (17-18). In fact, this elder helps Okonkwo consolidate his presence in the community since he is convinced that "you can tell a ripe corn by its look" (20). For the narrator, nature is the source of the most vivid comparisons. Ikemefuna, the child Okonkwo had adopted, is said to have been growing in his household "like a yam tendril in the rainy season" (47). When Okonkwo's favorite daughter Ekwefi is frightened, the narrator tells us that she is "like a hen whose only chick has been carried away by a kite" (93). When her fear becomes that of the community, the narrator notices fireflies going around "with their tiny green lamps, which only made the darkness more profound" (94).

Achebe makes it quite clear that for the story-teller of a people who live in harmony with the land, nature is the source of all the figures of speech necessary for their story-telling. In Chapter 11 of the novel we have a story-telling episode where Ekwefi, another of Okonkwo's wives, narrates the story of a tortoise and birds to her daughter Ezinma. When she finishes her story Ezinma herself begins to narrate another story; this time one about a tortoise and cats. Noticeably, everything ends up as a story. In the stories of the clan, nature plays an integral part and often provides the characters as well as the metaphors. Thus when towards the end of the narrative the humiliated clan men try to organize and put up resistance against the invaders, the strategy they are asked to adopt is compared to the one that Eneke the bird used "to fly without perching like a twig" (183). It is significant that the proverbs and the metaphors of the first part of the story begin to disappear as the whites make their presence felt in Umuofia. The proverbs that replace them are often from the tradition of the white colonizers. In one obviously ironical instance, we learn that Mr. Smith punished a woman who had converted to Christianity "for pouring new wine into old bottles" (166). But the more repugnant Mr. Brown seems to see only through a reductive perspective based on the principle of puritan allegory where "the world was a battlefield in which the children of light were

locked in mortal conflict with the sons of darkness" (166).

The district commissioner for his part uses an animal metaphor, but there is obvious irony in his telling the clan men that if they played "any monkey tricks they would be shot" (186). The one noteworthy metaphor associated with the clan in the concluding chapters is, one that is from everyday experience that has become folk wisdom, for one of the elders talk about their predicament as comparable "to a toad jumping in broad daylight" (182), a sure sign of desperation. To the Umuofians nature in its bounty provide them with endless images with which they can weave their proverbs, metaphors and stories. To the whites the native mode of speech seems wasteful and decorative. This, at least, is what goes through the irate District Commissioner's mind when he is trying to find out where Okonkwo has disappeared, for he thinks then: "one of the most infuriating habits of these people was their love of superfluous words" (185). At this level, Things Fall Apart dramatizes what the critic Ato Quayson has called " the struggle between an organic esthetic…indigenous to the culture and an esthetic…that comes with colonialism" (833). Overwhelmed by the whites, the proverbs and the metaphors of the Igbos seem to suffer like the people themselves. No doubt because the district commissioner is intent on straightening out the language and the narratives of these people as well as their politics, he resolves to title his account of his experience in the region, "The Pacification of the Primitive Tribes of Lower Niger" (Achebe, Things, 187). But Achebe himself takes the opposite tack in writing his tale of the way things fell apart for his country. His mission was to bring the land and its stories alive by using a vibrant narrative strategy dependent on indigenous story-telling traditions and techniques. As he puts it in his famous essay, "Colonialist Criticism': "every literature must seek the things that belong unto its peace, must, in other words, speak of a particular place, evolve out of the necessities of its history, past and current, and the aspirations and destiny of its people" (Achebe, Hopes,74).

Chinua Achebe's *Things Fall Apart* has indicated that he has presented through his novel a West African world whose inhabitants had bonded with their physical surroundings, learning to live in it, respect, and get sustenance from it. They had made their landscape a place where memory, work, cultural practice, and rituals had intermingled, creating a balance in their lives that made life meaningful for them. People had become one with place and culture and nature had merged for the Igbo. Achebe, tried to show, had drawn inspiration from his remembrance of a time when his people had adjusted themselves to their environment and felt that there was something from it that present-day Africans would learn from. He had, it can be said, been inspired by his ecological consciousness to write his narrative of Umuofia and its inhabitants. Wendell Berry, a major American poet and advocate of the environment movement has observed that: "A human community… must collect leaves and stories, and turn them to account. It must build soil, and build that memory of Chinua Achebe's *Things Fall Apart* Eco-critically itself" (Garard, 115) and it is part of Achebe's achievement to have done so in his novel. But Achebe's success as a novelist in Things Fall Apart is also to show how the coming of imperialism had impacted adversely on the lives of people who had been dwelling in harmony with nature and how the coming of the whites had disturbed the balance achieved by the West Africans in their dealings with their environment.

Achebe through his narrative strategy, his use of time, and his mastery of language and deployment of proverbs and metaphors, he has succeeded in depicting the manner in which the community became troubled and the land became polluted by the advent of colonization. By the time he concludes the novel we come to realize that the Igbo world had become traumatized and the complex ties forged between nature and society by the clan had become unsettled because of the actions of men like Mr. Brown and the District Commissioner. This paper has attempted an eco-critical reading of Achebe's great novel to show how he wrote it from what would now be called an ecological consciousness to suggest that Africans learn to value the land that they dwell in and to point at the importance of respecting the natural world. Achebe wrote Things Fall Apart, of course before the discipline called Eco-criticism was born.

Ursula K. Heise, an American proponent of Eco-criticism, has defined the parameters of the subject thus: 'Eco-criticism analyzes the ways in which literature represents the human relations to nature at particular moments of history, what values are assigned to nature and why, and how perceptions of the natural shape literary tropes and genres" (1097). Hopefully, this reading of *Things Fall Apart* has shown that Eco-criticism as a subject has a lot to offer us as we attempt to offer new readings of the texts emanating from our part of the world.

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ECO CRITICISM IN THE HUNGRY TIDE

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ABSTRACT

The novel speaks about the efforts taken by Piyali Roy, an Indian American biologist to make a study on marine mammals, especially on Irrawaddy dolphins.The novel is set in Sundarbans. Piya arrives at Sundarbans which is considered by her as a suitable place for carrying out her study. She lands on an island in Sunderbans and gets acquainted with an inhabitant of that place named Fokir. He remains to be a guide for her and instructs her about the marine habitats. Fokir being a resident of that place, he knows about the tides occurrence in the seas and the perils. Though he knows these, to the dismay of the readers, Fokir dies when a storm breaks out followed by heavy rain and powerful and devouring tides. As ideas given by Fokir could be the sources for decades of 'research', with the sponsorship of Nilima and involvement of local fisherman, Piya starts an institution in the memory of Fokir. The novel deals with the dislocation of people due to tide. Tide causes great havoc to the life and property of the inhabitants of the islands in Sunderbans. The poor people who have become victims of natural catastrophe suffer from hunger. I would like to bring out the human environmental relationship in the novel. Human beings depend on nature and environment. Eco Criticism on this novel helps to evaluate this literary text in the literature and environment perspective.

Keywords: Tide, Catastrophe, Hunger, Human environmental relationship.

Piyali Roy is an Indian American biologist who arrives at an island named Lusibari in Sundarbans to carry out her research on marine mammals. Fokir who is an inhabitant of Sundarbans helps Piya (Piyali Roy) to conduct her research. Fokir helps Piya in foretellingthe occurrences of tides, presence of marine mammals and especially the location of Irrawaddy dolphins in marine. The eco critical point of view has been chosen to explore this literary text in environmental perspective. The study of literature and environment in *The Hungry Tide* with environmental concerns examine the various ways of literature treating nature.

This novel highlights the dislocation of the refugees caused by nature and the government. Let the dislocation caused by nature be examined as this is the topic the paper is concerned with. The novel is set in the Sundarbans, which means 'the beautiful forest'. People believe that the word is derived from the name of a common species of mangrove the Sundari tree. But in the record books of the Mughal emperors this region is named not in reference to a tree but to a tide-*bhati.* To the inhabitants of the islands this land is known as *bhatirdesh*- the tide country. The description of the tide country itself provides a picture of dislocation places. This tide country is an immense archipelago of islands stretching from the Hooghly River in the West Bengal to the shores of the Meghan in Bangladesh. Some of these islands are "immense and some are no larger than sandbars; some have lasted through recorded history while others were washed into being just a year or two ago" (7). In this area the river channels spread across the land like a fine mesh n*et* They have created a terrain "where the boundaries between land and water are always mutating, always unpredictable" (7).

In the Sundarbans when the tides create new land, mangroves begin to gestate overnight and cover a new island within few short years. Other kinds of trees are not found here, mangrove forest is a universe unto itself. The mangrove is impassably dense. Every year dozens of people perish in the embrace of that dense foliage, killed by tigers, snakes and crocodiles. By providing the background of mutating, fluctuating, transient islands and boundaries of islands, Ghosh propounds that dislocation is not just human creation it is a natural phenomenon present since the origin of the earth.

One could decipher the lives of Sundarbans inhabitants from a thorough reading of this novel. This novel explains the havoc caused to the island people of Sundarbans. Especially it speaks about the loss of lives and livelihood in Lusibari. People of Sundarban islands are subjected to calamities such as storm, tides and flood. They are also devoured by hungry tigers in Sundarbans mangrove forest and attacked by venomous snakes, crocodiles and whales in the sea. These are the environmental issues face by the people of islands in Sundarbans. Amitav Ghosh who is very much acquainted with Bengal life and subsequently shows interest in Indian ocean churns well the novel with all details of Bengal and Indian ocean.

Piya when she arrived for the first time in Sundarbans is saved from getting drowned into the salty vegetative marine water by Fokir. She then finds Fokir to be a real source for her in providing elements of information for her research. Though Fokir does not know English, he and Piya are able to communicate by other means. Fokir is a subaltern of a Sundarban island and he and his people are widely prone to political, natural, and social issues. However Fokir loses his life in a storm that raised the hungry tides and devoured his life. The other inhabitants of Sundarban islands also lose their life day by day by some or other environmental issues. It has been found that not even a single day is spared by bringing the news of dead people in Sunderban islands.

The people of Sunderbans live with fear that their life in unsecured. Each and every day is seen with some or other disaster. Ghosh has portrayed this pathetic trauma of island inhabitants in the following lines:

There are no borders here to divide fresh water from salt, river from sea. The tides reach as far as three hundred kilometers inland and everyday thousands of acres of forest disappear under water only to re-emerge hours later. The currents are so powerful as to reshape the islands almost daily- some days the water tears away entire promontories and peninsulas; at other times it throws up new shelves and sand banks where there were none before (7).

None has a palpable concept for stating the occurrence of tides, floods, storms or cyclones. It is all associated to natural setup and intervention in it. Nilima and Nirmal who are aunt and uncle to forty two year old Kanai Datta have experienced a lot of miseries and sufferings in Sundarban islands. This explains how Nirmal is killed in a massacre called Marichjhapi massacre. Nilima mentions in the novel that she could find many young widows as their husbands lost their lives for tides and cyclones at sea.

Hunger is one of the foremost issues which is experienced by the island inhabitants. They muster up their courage and go for fishing to get something to eat. To the consternation of everyone, they become victims to the fishes and sea. But still going for hunting and fishing continues as the people of Sundarban islands need food for their livelihood.

The hunger drove these people to hunting and fishing and the results were disastrous many died of drowning; many more were picked off by crocodiles and sharks. The mangroves also didn't help the people; thousands risked their lives to collect meager quantities of honey, wax, firewood and fruits. No day seemed to pass without news of someone being killed by a tiger, a snake or a crocodile.

The occurrence of cyclone and flood is the common phenomenon in the tide country. Horen narrates his own experience of being caught in one such cyclone. Once when Horen and his men were on the water, immediately the water level rose. They tied the boat to the tree trunk; they climbed up and sat on the branch of a tree. Looking around he saw that they were not the only people to take shelter in a tree. Many others had saved their lives in similar fashion. Whole families, young and elderly alike, were sitting on branches. They spent two days on the tree, without food or any water. Many had been blown away by the storm. When the flood subsided they look around, "there were corpses everywhere and the land was carpeted with dead fish and livestock. They found out that three hundred thousand people had died" (350). So also Nirmal records in his diary about the worst storm that had hit the tide country.

The water rose so high that they killed thousands of animals and carried them upriver and inland. The corpses of tigers and rhinoceroses were found kilometers from the river, in the rice fields and in village ponds. There were fields covered with feathers of dead birds. They say there was not a building in the city left with four walls intact. Bridges were blown away, godowns were emptied their rice, and on the river were many ships at anchor, large and small. The wind picked them up and carried over the top of trees and houses. They say that over twenty vessels were lost that day, including boats, dinghies and the like (204).

Hunger and catastrophe remain unaltered in the lives of island inhabitants. They survive by facing lots and lots of troubles day by day. These are all due to ecological imbalance or ecological turbulence. The novelist has very well made clear to the readers how literature examines environment. *The Hungry Tide* provides an insight into the human environment relationship as well as literature environment relationship.

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THE POEMS OF WILLIAM WORDSWORTH: AN ECOCRITICAL OVERVIEW

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ABSTRACT

Eco-criticism emerged in the 1990's and the critics changed their angles of vision and examined the works of art by focusing on the relationship between man and Nature. William Words worth, in particular, became the key icons of eco-critical studies. Wordsworth was a major English Romantic poet who has been considered as a forerunner of English Romanticism. His views towards Nature and man's treatment of Nature have supported his position as an important icon of eco-critical studies. His fame lies in the general belief that he has been viewed as a Nature poet who viewed Nature superior to humans. In other words, his views about Nature and his poems seek to heal the long-forgotten wounds of Nature in the hope of reaching unification between man and Nature. With the emergence of Eco-criticism as a new critical approach in the 1990's, Romantic poetry, in general, and William Wordsworth, in particular, became the icons of eco-critical studies. He was the foremost Romantic poet who cared for the creation of symbiosis between man and Nature. William Wordsworth was a major English Romantic poet who is considered as a forerunner of English Romanticism. His contributions to the repository of English literature are undoubtedly a token of his greatness among his contemporaries. His views towards Nature and man's treatment of Nature have supported his position as an important icon of eco-critical studies. His fame lies in the general belief that he has been viewed as England's greatest Nature poet who viewed Nature superior to human being whose survival is dependent upon Nature. Wordsworth intends to show the value of survival of human being in Nature. Though literary critics talked about the eco-critical concepts in the past, the present paper highlights a recent literary approach to Eco-criticism studies, "the relationship between literature and physical environment" in the poems of William Wordsworth.

Keywords: British Poetry, Wordsworth, Ecocriticism.

William Wordsworth was a major Romantic poet, based in the Lake District, England. His poems are frequently inspired by the beauty of nature and he is known as one of the greatest English poets who created a more spontaneous and emotional poetry. It sought to depict the beauty of nature and the quintessential depth of human emotion. In the preface to Lyrical Ballads*,* Wordsworth writes of poetry that it is "the spontaneous overflow of powerful feelings: it takes its origin from emotion recollected in tranquillity. He developed a great love for nature, spending many hours walking in the fells of the Lake District. William Wordsworth was born on 7 April 1770 in Cocker mouth, Cumberland, in the Lake District.The magnificent landscape deeply affected Wordsworth's imagination and gave him a love of nature.He also became very close to his sister, Dorothy, who would later become a poet in her own right. Wordsworth.

"Ecocriticism is the study of the relationship between literature and the physical environment (Glotfely and Fromm, 1996)"

Eco-criticism emerged in the dawn of an era which environmental pollution and industrial destructions and decay is a serious problem of humanity. Eco-critical theory investigates the relationship between human activities and the natural world, particularly in terms of the influence of each upon the other. Within this broad theoretical field, eco-feminist theory studies women's particular impact on the relationships between the human and natural worlds, and women's potentials to promote the desirable human relationships to the natural world as a way to get over the environmental crisis today. When it foremost stresses sensual and spiritual experience with the outer world for individual and cultural changes, the function of art as healing power is stressed. This is an effort for the recovery of human organic or primordial unity with nature in which the distinction between subjectivity and objectivity blurs. Newborn the Eco-criticism is, it tries to discover and highlight the links between ecology and other fields of study like film, ethics, history, psychology, women's studies, Native American Studies and literature. Eco-criticism emerged in the dawn of an era which environmental

pollution and industrial destructions and decay is a serious problem of humanity

Wordsworth poetic process is that which the internal makes external. In his poetry external nature is in connection with the internal feelings of the po*et* This aesthetic process is highly important to reveal Wordsworth attempt to bridge the gap between Nature and man. The poetic persona whom we identify with Wordsworth himself, takes solace and peace at the bosom of nature. Wordsworth poetry is not only the reflection of poet's spiritual dimension but a fact that proves Wordsworth ties with Nature.

For Romantic poets, the imagination is a process of the mind that is deeply emotional and nearly indescribable, which is why it is such a prominent theme in their poems. For critics who study Romantic poetry, the definition of imagination is malleable, which makes for an attractive topic and greatly differentiated criticism. Wordsworth was one of the Romantic poets most intent on interpreting, defining, and exploring the imagination. Wordsworth's preface to Lyrical Ballads the poet intends to link "thought-forms" with "material forms" of daily living; that is, Wordsworth connects the world of real objects to the inner workings of his mind. . Even in Wordsworth's earlier projects, he is attentive to how one's mind affects one's surroundings. Wordsworth places the speaker in the middle of Nature and shows that Nature is right and loyal to human being in its turn and it is man who should take the blame for the broken bond between him/her and Nature:

"I heard a thousand blended notes,
While in a grove I sate reclined,
In that sweet mood when pleasant thoughts
Bring sad thoughts to the mind."

"Lyrical Ballads includes some of his best known poems, such as, "Lines Composed A Few Miles above Tintern Abbey", "A Slumber Did my Spirit Seal".

"A slumber did my spirit seal;
I had no human fears:
She seemed a thing that could not feel
The touch of earthly years.
No motion has she now, no force;
She neither hears nor sees;
Rolled round in earth's diurnal course,
With rocks, and stones, and trees."

Elsewhere, in The Ruined Cottage, there is a reference to Nature's bestowing her favours upon man despite man's disrespectful treatment of nature and his/her disturbing the ecosystem: …

"Beside yon spring I stood
And eyed its waters till we seemed to feel
One sadness, they and I. For them a bond
Of brotherhood is broken: time has been
When every day the touch of human hand
Disturbed their stillness, and they ministered
To human comfort....."

These lines can support Wordsworth's ecological position as a poet of Nature and serve as a justification for the union of the above-mentioned critics who rely on Wordsworth's contributions to the rise of the ecological awareness of human beings.

The "Preface to Lyrical Ballads" is not a systematic poetics, but a partly polemical, partly pedantic, and still problematic statement of Wordsworth's beliefs about poetry and poetic language. The preface in all its versions is highly discursive, the poet "thinking aloud" in an attempt to formulate ideas about poetry based on poems he has already written. It is important to remember when reading the preface that it both chronologically and logically follows the composition of most of the poems. The two central ideas of the preface are the need for reforming poetic diction—which, according to Wordsworth, had become far too artificial—and the role of the poet in society, which Wordsworth saw as having become too marginal. He had also come to the conclusion that the troubles of society were specifically urban in nature. This view finds eloquent expression in Wordsworth's most powerful early poem, "Tintern Abbey." Thinking of the way in which his memories of the Wye River valley had sustained him, Wordsworth wrote:

"Though absent long,
These forms of beauty have not been to me,
As is a landscape to a blind man's eye:
But oft, in lonely rooms, and mid the din
Of towns and cities, I have owed to them,
In hours of weariness, sensations sweet".

The poem concludes with a meditation on the power of nature to prevail against the false and superficial "dreary intercourse of daily life" that Wordsworth associated with city life, especially literary life in London. In the preface, Wordsworth characterized those forces as acting against the elevation of mind in which the poet specializes, and he identified them with urban life.He published another important volume of poetry "Poems, in Two Volumes", this included famous poems such as; "The

Daffodils", "My Heart Leaps Up", "Ode: Intimations of Immortality".

"I wandered lonely as a cloud,
That floats on high o'er vales and hills,
When all at once I saw a crowd,
A host, of golden daffodils;"

Accordingly, the ballad is a spiritual dimension but a fact that proves Wordsworth ties with Nature. "Lines Written in Early Spring" is analyzed from Eco-criticism lines. While he watches the harmonious music of Nature and thinks of disharmony of man with Nature, he mourns the alienation of man with Nature. He tells about Nature's dynamic development when he describes how the periwinkle trains its branches through the grass. The poet emphasizes the harmony in the Nature. Invited to reunion with Nature, Wordsworth rejects anthropocentrism resulting from industrial progress in which man is superior to Nature. He encourages bio-centrism in which man and Nature are in harmony and equality. Accordingly, the inter-connectedness between man and Nature can save both

Although Eco-criticism is in infancy and has developed newly in our age, literature has mirrored humankind's concern towards nature since centuries ago. In this comparative study, poems of two Romantic poets had been discussed from deep Eco-critical lens because nature is the main personal and poetic concern of them. Deep ecology emphasizes the monism of man and nature: "the shift from a human-centred to a nature-centred system of values is the core of radicalism attributed to deep ecology"

His poem "Lines Written in Early Spring" juxtaposes the sense of threat to destruction of Nature and poet's attempt to rejoin man and Nature. Wordsworth envoys the harmony that exist between natural elements and he mourns disharmony in the relation between man and Nature. From theoretical aspect of deep ecology, Wordsworth demands human being to redefine its relationship with nature. He invites to self-awareness that leads to identification with Nature. It removes the superior position of man on Nature in the modern age and places him/her in an equal situation

Using Wordsworth's imagination as a lens, one can see how much broader critical approaches have become with the shifting focuses of different theories. And as they explore the imagination, scholars elucidate their modes of inquiry and exemplify the novel aspects of their schools. Although these schools of literary criticism have vastly different methodologies and often-inconsistent conclusions, as the scope of critical materials continues to expand over time one central issue remains: understanding Wordsworth's imagination in 'The Prelude'. By way of understanding and appraisal, it must first be asked what Wordsworth set out to do and then to what degree he succeeded. It has been remarked that he was one of the giants; almost single-handedly he revivified English poetry from its threatened death from emotional starvation.

By using language to blend the impossible and the actual, he demonstrates the power of the imagination and gives his readers a better understanding of what he desires from reality. In addition to the imagination, the deeper, symbolic meaning of this passage is a key: Wordsworth must come to terms with the disappointment of the hike, an allegory for his coming to terms with many disappointments and unexpected turns in his adult life. Thus, Wordsworth can use situations from the past and from the present, forcing readers to draw meaning from the similarities as well as the differences. His memory calls to mind situations, and his imagination creatively connects them. Wordsworth's emphasis on human being's dependence on Nature for survival is clearly shown in 'The Ruined Cottage', wherein he says:

"At length [towards] the [Cottage I returned]
Fondly, and traced with milder interest
That secret spirit of humanity
Which, 'mid the calm oblivious tendencies
Of nature, 'mid her plants, her weeds, and flowers,
And silent over-growings, still survived".

One of Wordsworth's finest achievements was that his simple childhood readied his mind to the value of the non-artificial, and he was not slow to appreciate the need for a reform of "poetic" language. Poetry became an immediate and intimate experience told by the experience. Beauty was to be admired for its own sake. Wordsworth's reliance on unaffected speech and action and his deep conviction that simplicity of living was a philosophy harmoniously in agreement with nature wrought a revolution in poetic values. His Preface to the *Lyrical Ballads* became the symbol and the instrument of romantic revolt. Wordsworth's philosophy of life, his theory of poetry, and his political credo were all intricately connected. A change in one characteristically brought parallel changes in the others.

In contrast to this belief, several eco-critics reject Wordsworth as an ecological thinker and believe that he values human imagination more than Nature and has an objectified view towards Nature. As a matter of fact, Wordsworth's aim in granting superiority to Nature was an effort to broaden human beings ecological horizons and show that Romantic view of Nature was "a search for holistic or integrated perception, an emphasis on interdependence and relatedness in nature, and an intense desire to restore man to a place of intimate intercourse with the vast organism that constitutes the earth"

Wordsworth is upset with the modern man's neglectful treatment of Nature and shows that the punishment of him/her is the unification of the natural elements from which man is banished; "For this, for everything, we are out of tune; / It moves us not...."

Wordsworth attacks "the objectivity of our conventional ways of knowing", doubting about the possibility of a "conversation" between man and the natural objects in the world, where the speaker of the poem says:

"The eye—it cannot choose but see;
We cannot bid the ear be still;
Our bodies feel, where're they be,
Against or with our will. … —
Then ask not wherefore, here, alone,
Conversing as I may,
I sit upon this old grey stone,
And dream my time away."

Wordsworth is a poet who never seems far from critics' minds. It seems that new generations of critics never tire of evaluating and re-evaluating the ideas found within Wordsworth's poetry, and reinterpreting their significance for a new generation. Towards the end of his life, his disillusionment with the French revolution had made him more conservative in outlook.. He was persuaded to become the nation's poet laureate; despite saying he wouldn't write any poetry as Poet Laureate. Wordsworth is the only Poet Laureate who never wrote poetry during his time as Poet Laureate. It is within this whirlpool of critical voices that Wordsworth's poetry exists for us today. Wordsworth's sonnet, "The World Is Too Much with Us", written in 1802, can be a good justification for argument wherein the speaker says: The world is too much with us; late and soon, Getting and spending, we lay waste our powers: Little we see in Nature that is ours; We have given our hearts away, a sordid boon!

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CORROSION INHIBITION PERFORMANCE OF PINK, ORANGE AND WHITE COLOURED *BOUGAINVILLEA GLABRA* BRACT EXTRACT ON MILD STEEL IN 1N HCl

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ABSTRACT

The present study was undertaken to find out the phytochemicals present in *Bougainvillea glabra* bracts extract and to compare the corrosion inhibition efficiency between *B.glabra* Pink, Orange and White coloured bract extract on mild steel in 1N HCl. Phyto chemical analysis showed the presence of alkaloids, flavonoids, phenolic compounds and tannins in the extract as confirmed by implying different qualitative tests specified for these phytochemical. Corrosion rate, inhibition efficiency, FTIR analysis was determined. The corrosion of mild steel in 1N HCl acid media was significantly reduced upon the additions of BG bract extracts. The inhibition efficiency increased with the increasing concentration of the inhibitor. Maximum inhibition efficiency was observed at an optimum concentration of 2 % v/v.

Keywords: *Bougainvillea glabra* bract, hydrochloric acid, mild steel, weight loss, FTIR.

1. INTRODUCTION

Corrosion is a major problem that must be confronted for safety, environmental and economic reasons. The use of inhibitors is one of the most practical methods for protection against corrosion. The role of inhibitor is to form a barrier of one or several molecular layer against acid attack (Patel 2009). Protective action is often associated with chemical or physical adsorption involving in charge of, adsorbed substance and transfer of charge form one phase to another phase. Most of the efficient corrosion inhibitors used in industries is organic compounds having multiple bonds and hetero atoms like nitrogen, oxygen, sulphur, through which they are adsorbed on the metal surface. They function by interfering with either the anodic or cathodic reactions or both (Vinod Kumar *et al.,* 2010).

Mild steel is severely prone to corrosion in acid medium. Acid solutions are often used in industry for acidification of oil wells, cleaning of boilers, descaling and pickling of mild steel (Raja, 2008, 2009). All these processes are normally accompanied by considerable dissolution of metal. Looking at the increasing use of the metal, the study of corrosion inhibition is of paramount importance and hence several protective measures are being adopted (Putilova 1960). Rate of metallic corrosion can be reduced by the addition of inhibitors. Thus, in the present work mild steel was selected for corrosion inhibition studies.

This study aimed at using three differently coloured bract extracts to inhibit corrosion of mild steel in acidic medium. The inhibition efficiency of Pink, Orange, and White coloured *Bougainvillea galbra* bract extracts in 1N HCl on mild steel, at various inhibitor concentrations, various immersion periods using weight loss method and surface examination analysis by FTIR.

2. *BOUGAINIVILLEA GLABRA*

Plants have always been a part of medicinal science from the beginning of human civilization to the present modern world of synthetic medicines. Even in the presence of variety of effective synthetic drugs, use of medicinal plants for maintaining human health has acquired a lot of importance in the present era. There is a global interest in non-synthetic, natural drugs derived from plant sources, because of low cost, nontoxic nature and availability. Many plants with antioxidant potential possess flavonoids and phenolic compounds. Free radical reactions have been implicated in the pathology of many human disease including atherosclerosis, ischemic heart disease, the aging process, inflammation diabetes and other conditions. The research for medicinal plants discovered various common plants having distinguishable medicinal properties, among which one is *Bougainvillea glabra*. *Bougainvillea glabra* is an ornamental flowering plant from the genus of bougainvillea; family Nyctaginaceae and a native to Brazil. The genus bougainvillea has eighteen species, of which *B. spectabilis, B. glabra* and *B. Peruvian* are horticultural important. *Bougainvillea glabra* is a woody climber with thorny thin stems and long branches; also it has

papery bracts and smooth leaves, which grows to more than 10 meters of height (Bhaskara Rao *et al.,* 2015).

B. glabra is one that is great for container plantings and produce brilliant colours. The plant is perfect for arbors and draped long fences where it creates a security barrier by its thorns and twiggy growth. Body has itself antioxidant system, which reacts with reactive species and neutralizes them. This natural antioxidant system includes enzymes like catalase, superoxide dismutase and glutathione, which protect the body from free radical species and prevent oxidative stress. Synthetic antioxidant like butylated hydroxyl toluene and butylated hydroxyl anisole are carcinogenic in nature. So, there arises a need for natural antioxidant. The antioxidant activity of the hydroalcoholic, acetone extracts of the leaves have been evaluated for this plant (Mariajancyrani *et al.,* 2013). With this background, the aim of the present study was to determine the possible phytochemical with antioxidant activity of pink, white and orange coloured *Bougainvillea glabra* bract (Figure.1) for the corrosion studies.

Fig. 1. Pink orange and white coloured *Bougainvillea glabra* flower

3. MATERIALS AND METHODS

3.1. Charecterization of plant material

3.1.1. Collection of plant materials

The study was carried out on the pink, orange and white coloured *Bougainvillea glabra* bract extract. The flowers were obtained from Pillur dam, Coimbatore, India. The dried sample was ground into powder using an electronic blender sieved and the fine power was stored in air tight container. Figures 2-4, represents white colour *Bougainvillea glabra* bract powder, pink bract powder and orange bract powder respectively.

Fig. 2. White colour *Bougainvillea glabra* bract powder

Fig. 3. Pink colour *Bougainvillea glabra* bract powder

Fig. 4. Orange colour *Bougainvillea glabra* bract powder

3.1.2. Phytochemical screening

Each extract of *Bougainvillea glabra* bracts was subjected to preliminary photochemical screening to identify the chemical constituents of the plant. The methods of analysis were carried out using standard quantitative methods as described by various researchers Kotate (1999, 2010) and Harborne (1984, 1999).The samples were screened for the presence of bioactive compounds.

3.2. Corrosion studies

3.2.1. Preparation of the inhibitor

25g of dried powder bract was boiled in 500ml of 1N HCl acid with reflux condenser for three hours and was kept overnight to extract its phyto

nutrients (Fig. 5). The extract was filtered and the filtrate volume was made up to 500ml using the 1N HCl acid. The extract so prepared was taken as 5% stock solution and from this other concentration were prepared in similar manner (Rekha, 2010).

Fig. 5. Photograph of experiment set up for obtaining extract using reflex condenser

3.3.2. Corrosion monitoring techniques

The influence of the inhibition on the dissolution of mild steel in acid media was monitored chemically by weight loss method. Rectangular mild steel coupons of size 5x1x0.2cm were cut from a large sheet of mild steel, with a small hole of about 1.0mm diameter near the 1.5cm side end for suspending. The specimens were polished in sequence using silicon carbide emery papers of grade 200, 400, 600 starting with coarse one and proceeding in steps to the finest grade, then washed with distilled water dried with clean tissue paper, degreased with acetone and dried using hot air drier. The specimens were then kept in desiccators to avoid the adsorption of moisture (Hegazy *et al.,* 2011). Weight loss studies were conducted at room temperature. Mild steel specimens were weighed accurately in electronic balance (SHIMADZU model AUW 220D). After initial weighing, the specimens were fully immersed using glass hooks in beakers containing 100 ml of 1N HCl without and with inhibitor of different concentration at various intervals of time. After the specified period of immersion, the specimens were removed, washed with distilled water, dried and reweighed. The loss in weight was determined. The corrosion rate and inhibition efficiency was calculated from weight loss.

4. RESULTS AND DISCUSSION

The results of the phytochemical analysis, inhibition efficiency and surface analysis by FTIR and performance of pink, orange and white colour *Bougainvillea glabra* bracts in 1N HCl as inhibitors of corrosion for mild steel was compared.

4.1. Qualitative phytochemical analysis

Bougainvillea is a tropical and subtropical woody, evergreen, shrubby vine. The true, perfect bract is small, tubular, commonly white, pink, and orange surrounded by showy, vibrantly colourful petaloid bracts**.** Bracts many retain their colour for several months after the bracts have finished, gradually fading to resemble the colour and texture of paper.

Plants have always been a part of medicinal science from the beginning of human civilization to the present modern world of synthetic medicines. The research for medicinal plants discovered various common plants having distinguishable medicinal properties, among which one is *Bougainvillea glabra* (Farzana Rashid, 2013). With this background, the aim of the present study was to determine the possible phytochemical. The qualitative analysis of pink, orange and white *Bougainvillea* bracts extract showed the presence of reducing sugars, alkaloids, saponins, tannins, flavonoids, terpenoids, cycloglycosides, total phenols and sterols. (Table 1).

Table 1. Phytochemical compounds present in white, pink, orange *Bougainvillea glabra* bract extract Analysis

Phyto compounds	BG [white]	BG [pink]	BG [orange]
Carbohydrates	-	-	-
Reducing sugar	++	++	++
Alkaloids	+++	+++	+++
Saponins	-	-	-
Tannins	++	++	++
Flavonoids	+	+	+
Terpenoids	+	+	+
Phlobatannins	-	-	-
Coumarins	-	-	-
Cycloglycoside	++	+	+
Total Phenol	+++	++	++
Quinones	-	-	-
Anthraquinones	-	-	-
Sterols	+	+	+

Key words: '+++' Active compound copiously present, '++' Active moderately present, '+' Active compound present , '–' Active compound absent.

Table 2. Effect of concentration of P.B.G extract on corrosion of mild steel 1N HCl solution.

Conc. of extract (v/v)%	Inhibition efficiency (IE %)				
	1h	3h	5h	7h	24h
0.1	78.37	85.75	89.50	94.35	78.28
0.5	83.78	91.20	92.81	94.98	86.28
1.0	87.11	92.30	93.75	95.02	87.80
1.5	89.18	93.12	94.15	95.92	88.38
2.0	91.89	94.50	94.79	96.98	89.14
2.5	94.59	95.60	95.83	97.17	92.38

Table 3. Effect of concentration of O.B.G extract on corrosion of mild steel in 1N HCl solution

Conc. of extract (v/v)%	Inhibition efficiency (IE %)				
	1h	3h	5h	7h	24h
0.1	58.82	60.56	61.84	68.88	55.42
0.5	64.70	71.50	80.26	92.00	70.28
1.0	70.58	83.39	90.13	93.81	71.88
1.5	76.47	84.33	93.42	95.27	74.29
2.0	82.35	85.28	95.28	96.00	76.30
2.5	88.23	95.39	96.22	97.09	81.92

4.2. Weight loss method

Mild steel was found to corrode in 1N HCl acid solution. This was evidenced by the decrease in the original weight of the metal exposed to acid solution. On the addition of bract extract to the acids, it was found that the weight loss decreases with increase in concentration from 0.1 to 2.5 % v/v due to the adsorption of bracts nutrient which protects the metal surface from dissolution (Shymala Arulanantham, 2009), (Loto, 2011, 2012).

The maximum IE of 97.17% and 97.09% was noticed at 2.5 % v/v concentration of the inhibitor in 1N HCl for 7 h immersion period of mild steel for P.B.G and O.B.G respectively, a maximum IE of 99.33% was observed at 2.5% v/v concentration of W.B.G extract in 1N HCl for 5 h immersion period of mild steel. The inhibitor efficiency BG bract extract increased with an increase in the immersion time, since more adsorption takes place on the metal surface (Saratha and Vasudha, 2009).

4.3. FTIR analysis

FTIR spectra of mild steel treated with 1N HCl with BG bract extracts are displayed in Figure. 6 - 8, showed either a decrease in the transmittance or disappearance of some bands, giving a strong evidence for the functional groups such as OH, NH_2 and C=O leading to the formation of film of large surface coverage which serve as a barrier between the corrosive acid medium and the metal thereby inhibiting corrosion and also revealing the fact that *Bougainvillea glabra* bract extracts nutrients can adsorb on the metal surface on the basis of donor-acceptor interactions between lone-pair electrons of N and the vacant d-orbital of Fe substrate (Deng 2011, Harajothi Mazumdar, 2010a, b).

Table 4. Effect of concentration of W.B.G extract on corrosion of mild steel in 1N HCl solution

Conc. of extract (v/v)%	Inhibition efficiency (IE %)				
	1h	3h	5h	7h	24h
0.1	75.50	95.53	82.70	83.49	73.02
0.5	82.20	96.65	88.30	89.15	86.51
1.0	91.10	97.54	88.80	90.56	87.72
1.5	93.30	97.67	90.00	92.45	88.33
2.0	95.50	98.66	91.60	95.28	89.91
2.5	97.70	99.33	94.40	96.22	91.25

Table 5. Comparison of inhibition efficiency of the B.G bract extracts (pink, orange, and white) in 1N HCl on mild steel.

Conc. of extract (v/v %)	P/O/W B.G.B I.E (%)														
	1h			3h			5h			7h			24h		
	P	O	W	P	O	W	P	O	W	P	O	W	P	O	W
0.1	78	59	76	86	61	96	90	62	83	94	69	84	78	55	73
0.5	84	65	82	91	72	97	93	80	88	95	92	89	86	70	87
1.0	87	71	91	92	83	98	94	90	89	95	94	91	88	72	88
1.5	89	77	93	93	84	98	94	93	90	96	95	93	88	74	88
2.0	92	82	96	95	85	99	95	95	92	97	96	95	89	76	90
2.5	95	88	98	96	95	99	96	96	94	97	97	96	92	82	91

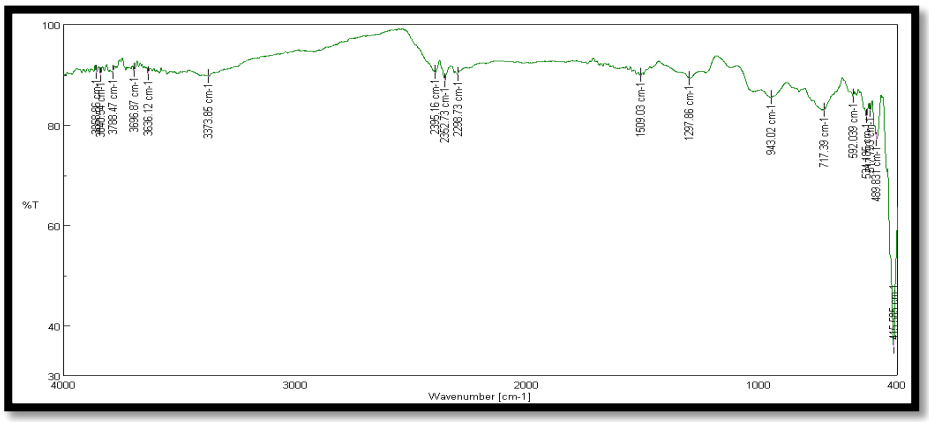

Fig. 6. FTIR spectrums for white colour B.G bract extract

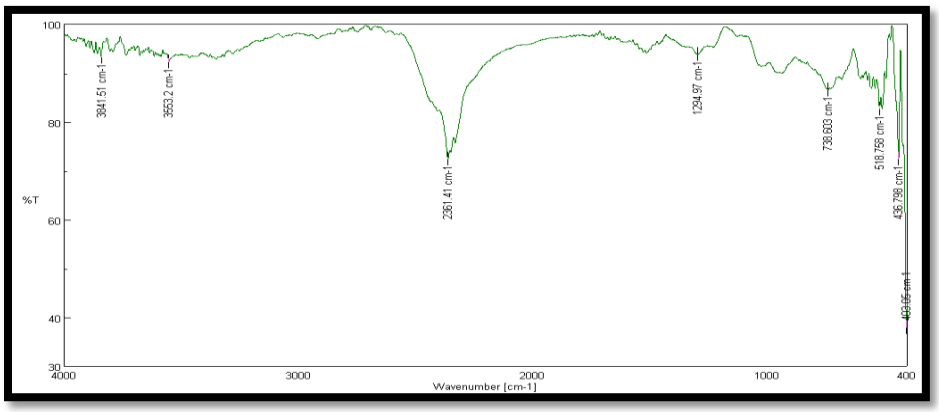

Fig. 7. FTIR spectrums for orange colour B.G bract extract

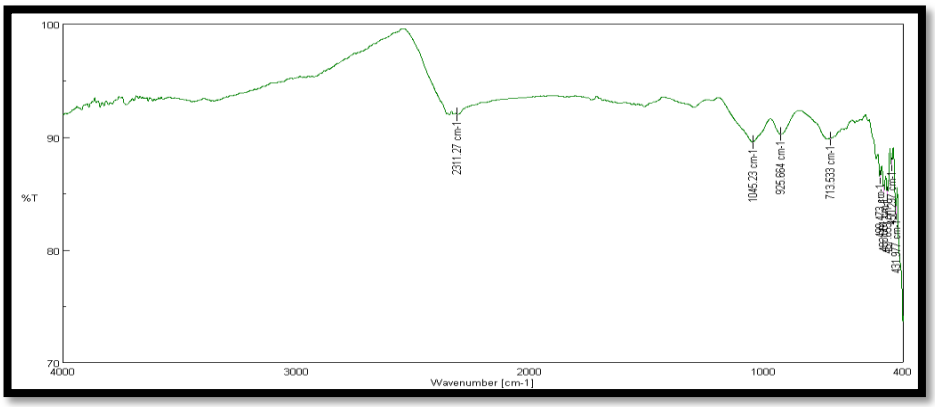

Fig. 8. FTIR spectrum for pink colour B.G bract extract

5. CONCLUSION

The corrosion rate of mild steel was monitored in 1N HCl medium at various concentrations of pink / orange / white *Bougainvillea glabra* bract extracts. Phytochemical analysis, weight loss and FTIR were employed in the present investigation. The following are the conclusions,

- The qualitative analysis of pink, orange and white *Bougainvillea* bracts extracts showed the presence of reducing sugar, alkaloids, saponins, tannins, flavonoids, terpenoids, cycloglycoside, total phenols, and sterols.
- The corrosion of mild steel in the HCl acid medium was significantly reduced upon the additions of BG bract extracts. The inhibition efficiency increased with the increasing

concentration of inhibitor. The maximum inhibition efficiency was observed at an optimum concentration of 2 %

- Maximum efficiency of 97.17%, 97.09 % and 99.33% was exhibited by P.B.G, O.B.G and W.B.G bract extracts in 1N HCl on mild steel 2.5 % v/v concentration respectively.

- Among the three coloured *Bougainvillea glabra bract* extracts (pink/orange/white) P.B.G and O.B.G showed maximum inhibition efficiency at 2.5% v/v for 7 hours of immersion. While W.B.G showed a maximum efficiency up to only 3 hours of immersion.

- FTIR analysis reveals that B.G pink, orange and white bract extracts contain possible function group for corrosion inhibition.

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PHYSICO-CHEMICAL STATUS OF POLACHIRA WETLAND ECOSYSTEM IN SOUTHERN KERALA

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ABSTRACT

Polachira wetland in Southern Kerala is a famousdestination of itinerant birds.Thebird aggregation in wetlands is always correlated to the abiotic and biotic factors of the ecosystem. The present investigation reveals the hydrology of the Polachirawetland during February to July 2014. The air and water temperature agreed with the climatic factors prevailed. The pH showed slight acidity and alkalinity. The total solids fluctuation was renderedby the Total Suspended Solid and Total Dissolved Solid which was indicated by organic discharge, high chloride content and salinity in water. Salinity in water was elevated due to the incursion of saline water from Paravur estuary to Polachira wetland through a canal. The free carbondioxide concentration did not show much variation but dissolved oxygen showed variation. The total hardness which was related to the calcium and magnesium hardness in water was determined.Alkalinity was balance in the ecosystem. Nutrients such as nitrite, nitrate, phosphate and silicate were in equilibrium concentration.Correlations of physicochemical parameters among six months were statistically significant.

Keywords: Polachirawetland, hydrology, nutrients.

1. INTRODUCTION

Wetlands are unique landscape which abode a great biodiversity. These ecotonesare saturated with countless forms of species of great ecological importance. This sensitive system preserves both aquatic and terrestrial ecosystems.In wetland the species richness is always enveloped around the hydrological regime of the environment. Nowadays anthropogenic input is elevating beyond a certain threshold level which has a profound impact on the water quality of the aquatic environment.India sustains assorted types of wetlands strewn across various eco- geographical regimes that comprises of wetlands in high altitude Himalayas to Deccan plateau.Kerala is bestowed with the most productive wetlands. Wetlands in Kerala are facing dwindling of ecological and economical valuesdue to high populace.The present investigation has been taken up the variations in the hydrology of Polachira wetland in Southern Kerala.

2. MATERIALS AND METHODS

The present study was carried out on the physico-chemical parameters of Polachira Wetland (8°50′26.89″N and 76°42′0.3″E) located in the Southern part of Kollam district in Kerala.The sprawling wetland spread over 600 hectares is on theem bankment of estuaries of the Ithikkara River and Paravur backwaters.It is an oval shape wetland at a depth of 1m below ground level and is encircled by small creeks and is densely vegetated. The samples were collected from five stations in the second week of every month during a period from February 2014 to July 2014. Physical parameters like Temperature and pH, were performed on the field. The physicochemical parameters like Total Solids (TS), Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Dissolved O_2, Free carbon dioxide, Total alkalinity, Total hardness, Calcium hardness, Magnesium hardness, Chloride, Salinity, Phosphate, Sulphate, Nitrite and Nitrate were analyzed as per the methods of APHA (1998) and Trivedy and Goel (1986). Data collected were subjected to proper statistical analysis. One-way analysis of variance (ANOVA) and Pearsoncorrelation coefficient was calculated to test the degree of relationship of water quality parameters between six months.

3. RESULTS AND DISCUSSION

The monthly variation (average value of different stations) of physicochemical parameters is given in Table 1. The temperature of both air and water is a remarkable regulatory factor governing the biogeochemical reactions of aquatic ecosystem. Monthly variation of atmospheric temperature in Polachira wetland ecosystem ranged between 30.1˚C and 36.6˚C during the month of June and March respectively.The present investigation revealed well marked variations in the atmospheric temperature. This may be due to the climatic conditions. Water temperature ranged from 29.6˚C (July) to 33.4˚C (March). The maximum and minimum temperatures may be due to the hot and cold climatic conditions.

Table 1. Monthly variation of physico-chemical parameters of Polachira wetland ecosystem during February to July, 2014.

Sl No	Parameters	FEB	MAR	APR	MAY	JUN	JULY
1	Atmospheric Temp.(˚C)	31.4	36.6	32.2	35.3	30.1	33.8
2	Water Temp. (˚C)	31.8	33.4	31.6	32.8	30.4	29.6
3	pH	6.63	7.23	5.88	8.28	6.34	5.97
4	Total Solid (mg/L)	1420	960	2160	900	740	560
5	Total Suspended Solid(mg/L)	460	320	500	360	280	220
6	Total Dissolved Solid (mg/L)	780	640	1680	540	460	340
7	Dissolved O_2 (mg/L)	4	3.4	4.08	3.6	6.3	3.9
8	Free CO_2 (mg/L)	15.14	15.1	17.03	14.64	15.36	14.12
9	Total Alkalinity (mg/l)	101	76	74	71	101	72
10	Hardness (mg/L $CaCO_3$)	364	380	300	292	276	160
11	Ca Hardness (mg/L $CaCO_3$)	41.022	96.162	85.762	60.9	68.932	46.49
12	Mg Hardness (mg/L $CaCO_3$)	50.692	34.136	20.476	21.442	25.342	10.712
13	Chloride (mg/L)	360.78	202.74	1177.8	760.38	864.76	536.76
14	Salinity (ppt)	0.6636	0.3870	2.1038	1.369	1.5548	0.9751
15	Nitrite (ppm)	0.0538	0.0057	0.0148	0.08368	0.0678	0.0516
16	Nitrate (ppm)	0.0536	0.0465	0.1399	0.7863	0.1899	0.1306
17	Phosphate (ppm)	0.0213	0.0177	0.0889	0.0174	0.0294	0.0296
18	Silicate (ppm)	16.013	12.787	12.1688	14.513	14.361	14.076

Table 2. Analysis of Variance of physico-chemical characteristics of Polachira wetland ecosystem during February – July, 2014.

One factor ANOVA

Mean	*n*	*Std. Dev*	
204.626	18	372.7767	FEB
156.556	18	265.3550	MAR
339.075	18	649.0492	APR
173.173	18	283.5576	MAY
162.263	18	266.3045	JUN
113.812	18	182.8021	JULY
191.584	108	366.9605	Total

ANOVA table

Source	*SS*	*df*	*MS*	*F*	*p-value*
Treatment	547,158.8997	5	109,431.77993	0.81	.5485
Error	13,861,463.1610	102	135,896.69766		
Total	14,408,622.0606	107			

Table 3. Correlation matrix of physico-chemical characteristics of Polachira wetland ecosystem during February – July, 2014.

Correlation Matrix

	FEB	*MAR*	*APR*	*MAY*	*JUN*	*JULY*
FEB	1.000					
MAR	.987	1.000				
APR	.950	.930	1.000			
MAY	.902	.873	.950	1.000		
JUN	.812	.778	.898	.983	1.000	
JULY	.869	.834	.936	.996	.993	1.000

18 sample size

± .468 critical value .05 (two-tail)

± .590 critical value .01 (two-tail)

pH showed a minimum and maximum value of 5.88 and 8.28 during the month of April and May. It is found that a slight acidic as well as basic in water may be induced by the improper use of fertilizers from agriculture field and garbage disposal.

The Total solids (TS) are a measure of both, the dissolved as well as suspended solids in watercomprising dissolved salts, suspended particles, soil particles, discharged effluents and decomposed organic matter (Patil *et al.,* 2011). In the present study the total solid varied between 560 mg/L (July) and 2160 mg/L (April). The total suspended solid was measured between 220 mg/L (July) and 500 mg/L (April). The total solid and total suspended solid may be resulted from the run-off water, which carries dissolved solids and also organic wastes from garbage dumping, agricultural land, waste water discharges and algal growth. A similar observation was reported by Chennakrishnan *et al.* (2008). A minimum total dissolved solid of 340 mg/L was observed in July and a maximum of 1680 mg/L was during the month of April.Presence of high TDS may be due to the high chloride and salinity contributed by the intrusion of saline water from Paravur estuary to Polachira wetland through a canal.

Oxygen content is a major parameter needed by aquatic life forms. The dissolved O_2 measured a lowest concentration of 3.4 mg/L in the month of March and the highest concentration of 6.3 mg/L observed during the month of June.Low oxygen concentrations are generally associated with heavy contamination of organic matter. In such conditions oxygen, sometimes, totally disappears from the water (Trivedy and Goel, 1986). Monthly variation of free CO_2 concentration ranged between 14.12 mg/L (July) and 17.03 mg/L (April).The wetland received more organic matter through surface run off and drainage and its decomposition might have resulted in the liberation of more amounts of CO_2 in the water column. The free CO_2 concentration change may be due to the micro bacterial activities, increase in temperature and biochemical reactions.

Alkalinity is a measure of acid present in water and of the cations balanced against them (Yogesh Shastri and Pendse, 2001). The presence of total alkalinity during the investigation period showed a fluctuation between 71 mg/L in May and 101 mg/L during the month of February and June respectively. The increase in total alkalinity was found to be associated with the rainfall and the subsequent surface run off and leaching.

The level of hardness was estimated between 160 mg/L $CaCO_3$ and 380 mg/L $CaCO_3$ during the month of July and March. High values of hardness are probably due to regular addition of large quantities of sewage and detergent into wetland from the nearby residential localities. Trivedi and Goel (1986) and Singh and Mahajen (1987) are of the view that the high hardness is suggestive of pollution due to domestic waste and industrial effluents.The calcium hardness value was recorded between a minimum of 41.022 mg/L $CaCO_3$ (February) and a maximum of 96.162 mg/L $CaCO_3$ (March). The amount of calcium increase may be due to rapid oxidation/decomposition of organic matter.

Monthly variation of magnesium hardness recorded between 10.712 mg/L $CaCO_3$ (July) and 50.692 mg/L $CaCO_3$ (February). Magnesium also occurs in all kinds of natural waters with calcium, but its concentration remains generally lower than the calcium (Trivedy and Goel, 1986).

Chloride is one of the factor governing the biota of aquatic system. The chloride content recorded lowest value of 202.74 mg/L (March) and maximum rate of 1177.8 mg/L (April). High and low chloride concentration was coincided with the salinity. The salinity ratewas measured between 0.3870 ppt (March) and 2.1038 ppt (April). Higher salinity content was due to the connection of Polachira wetland with Paravurestuary through a canal.

The nitrite content showed a variation between 0.0057 ppm and 0.0836 ppm. Presence of even a small quantity of nitrite will indicate the organic pollution and the availability of partially oxidized nitrogenous matter (Trivedy and Goel, 1986). The average nitrate concentration was measured between 0.0465 ppm (March) and 0.7863 ppm (May). The low rate of nitrite and nitrate concentration may be due to the utilization by the phytoplankton which was abundant during March. The increase in nitrate concentration may be due to the decaying of organic materials, discharge of sewage, natural runoff and agricultural wastes.

Phosphate is the nutrient considered to be the critical limiting nutrient causing eutrophication offresh water systems (Rabalais, 2002). The variation of phosphate concentration was between 0.0174 ppm (May) and 0.0296 ppm (July). The presence of phosphate in the wetland may be due to surface runoff during rainy season receiving huge quantity of domestic sewage, cattle dung and detergents from the surrounding catchment area. Monthly variation of silicate concentration showed a minimum of 12.168 ppm (April) and maximum of 16.013 ppm (February). High silicate content may be due to the soil erosion from catchment area.Analysis of variance of physico-chemical parameters during February to July 2014 showed that there is no significant difference in the mean value among months (Table 2). All correlations among six months were statistically significant (Table 3).

4. CONCLUSION

The monthly variations in physicochemical characteristics of Polachira wetland are providing a vivid knowledgeregarding the ecological status of wetland. This wetland is a preferred safe haven for resident and migratory birds. A frequent and continuous evaluation of this ecosystem is necessary to avoid dwindling of the resources.

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A PRELUDE ON THE BIOLOGY OF *PUNTIUS AMPHIBIUS*

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ABSTRACT

Knowledge on fish biology is essential for improving aquaculture. The present study was focused on the biology of *Puntiusamphibius*. The fishes were collected from a freshwater body in parlance known as "Arappa", located in Thalikulam at Thrissur district in Kerala. This water body is in the vicinity of the sea and debouches into the marine during monsoon season. In the present investigation 106 fishes were collected during March to August 2006. The study revealed that there was no significant difference observed among the length weight relationship of males and females. Composition of gut content showed that it is a selective feeder of Bacillariophyceae and a pronounced omnivore. The gastro-somatic index of female and male was high during May indicating the active feeding during breeding.The sex ratio between males and females was variable and female dominated over males. The fecundity of fish was proportional to the weight of the ovary. Gonado-somatic index was comparatively high during spawning seasons. This is a preliminary lesson on the reproductive biology and certain distinctive characters such as length-weight and food and feeding habits of *Puntius amphibius.*

Keywords: *Puntius amphibius,* gut content, gastro-somatic index, sex ratio, gonado-somatic index.

1. INTRODUCTION

Information on thefish and prey relationship is a prerequsiteon remarkable diversity of dietary patterns. The fecundity in relation to the body measurementsis an integral element in the estimation of biotic potential of fish. The genus *Puntius* under Cyprinidae family are prolific. The success of the *Puntius* occupying different niches within freshwater ecosystem depends upon the distinctive set of ecological, feeding and reproductive strategy. This is a preliminary lesson on the reproductive biology and selected individual characters such as length- weight and feeding habits of *Puntius amphibius.*

2. MATERIALS AND METHODS

The present study was carried out on the biology of *Puntius amphibius.* The fishes were collected from a freshwater body locally known as "Arappa" which is situated very close to the sea near Thalikulam at Thrissur district in Kerala. It cannot be described as a typical fresh water body as the saline ingressions are high in the water body during monsoon season. About 106 specimens were collected during the period from March to August 2006. Soon after the collection the specimens were fixed in 10% formal in and brought to the laboratory. Subsequently length-weight relationship and coefficient factor, food and feeding and reproductive biology were analyzed as per the methods of Biswas (1993).

3. RESULTS AND DISCUSSION

It was evident from the results of regression analysis (Table 1) that there was no significant difference between the slopes. The slope value (b) has found to be 1.7677 for males and 1.2261 for females. The 'r' value (correlation coefficient) was found to be significant at 1% level. The correlation coefficient for males being 0.9338 and for female was 0.5527. It showed that the Length-Weight relationship of male and female did not differ significantly among the sexes, which agrees with the observation of Chandrika (1984) in *Xenentodoncancila*. This also indicates that males and females of *Puntius amphibius* have similar growth rate.

The gut content analysis showed that food items comprised of Bacillariophyceae, Cyanophyceae, Desmidaceae, Chlorophyceae, Zooplankton, Organic matter and Sand particles (Table 2). Bacillariophyceae (34.12%) formed the major component of food. It occurred throughout the year with its maximum percentage composition was in August (37.63%) and minimum in the month of May (30.36%). Cyanophyceae occurred during all the months and ranked second among the algal components and occurred in maximum percentage in March (30.74%) and minimum in the month of

June (17.96%). Mean percentage composition of Desmidaceae was 13.53%. Maximum was recorded in May (18.32%) and minimum in the month of March (8.56%). Average percentage composition of Chlorophyceae was 9.41%. Its maximum was in March (10.93%) and minimum in May (6.50%). Zooplankton was comparatively lesser than all other food items. The mean percentage of zooplankton was 3.52%. Maximum zooplankton was attained in May (4.15%) and minimum percentage composition in March (2.78%). Organic matter in the form of dead and decaying part of aquatic plant was most commonly noticed. Their mean percentage of composition was 5.13%.The maximum was found in June (8.73%) and minimum in August (2.15%). Sand particles were also observed. Its mean composition was 10.15%. Maximum percentage composition of sand particle was recorded in May (14.11%) and minimum percentage was in the month of August (7.15%). Algae and diatoms formed the chief food items.Lower percentage of sand grains noticed in the gut may be due to their mode of feeding. Most of *Puntius* sp. is scooping out sand particles to select desired food items. The detailed dietary compositions substantiate that this fish is omnivore. From the gut content analysis, it is found that diatoms which formed the principal diet of fish. It predominated over the other food items in stomach during all months of the year. Mini (1996) observed that the major food items in *Puntius amphibious* collected from Pamba river system consists of detritus and algae followed by zooplankton and other aquatic organisms, which differ in the present study because of the dominance of diatoms. Such a high percentage of a single food may indicate a very steady source of the food organism available (Nikolsky, 1963).

Table 1. Regression analysis of Length-Weight relationship of *Puntius amphibious.*

Sex	r	Regression equation
Female	0.5527	Y=1.2261 X=3.4949
Male	0.9338	Y=1.7677 X=7.9164

Table 2. Percentage composition of various food items in total population of *Puntius amphibius.*

Food items	March	April	May	June	July	August	Average
Bacillariophyceae	34.59	31.10	30.36	36.68	34.36	37.63	34.12
Desmidaceae	8.56	14.31	18.32	14.70	13.54	11.73	13.53
Cyanophyceae	30.74	26.36	18.81	17.96	22.61	28.39	24.14
Chlorophyceae	10.93	10.59	6.50	10.35	8.12	9.98	9.41
Zooplankton	2.78	3.82	4.15	3.92	3.45	2.97	3.52
Organic matter	3.20	3.98	7.75	8.73	4.96	2.15	5.13
Sand particle	9.20	9.84	14.11	7.66	12.96	7.15	10.15

Table 3. Occurrence of stomach in various degree of fullness.

Month	No. of fishes	Empty	Poor	Medium	Good
March	22	---	8	8	6
April	28	8	5	10	5
May	20	1	4	10	5
June	16	5	5	5	1
July	10	2	1	5	2
August	10	2	2	4	4

Table 4. Gastro-somatic index of male and female *Puntius amphibious.*

Months	Gastro-somatic index of female	Gastro-somatic index of male
March	1.82	1.78
April	1.94	1.85
May	2.58	2.48
June	1.16	1.17
July	0.97	0.67
August	1.85	1.88

Table 5. Sex ratio of *Puntius amphibius* in monthly sample.

Month	No. of fish	No. of male	No. of female	Percentage of males	Percentage of females	Sex ratio Male: Female
March	22	6	16	27.7	72.72	1: 2.62
April	28	1	27	3.57	96.43	1:27
May	20	3	17	15.00	85.00	1: 5.6
June	16	3	13	18.75	81.25	1: 4.3
July	10	2	8	20.00	80.00	1.4
August	10	3	7	30.00	70.00	1:2.3

Table 6. Fecundity of *Puntius amphibious.*

Sl.No	Total length (cm)	Total weight (cm)	Ovary weight (mg)	Total no.of ova	Fecundity
1.	9.6	9.83	440	102	1026
2.	8.7	7.11	190	57	345
3.	9.5	8.36	170	102	1024
4.	8.7	7.70	510	112	1122
5.	9.4	9.64	220	106	1067
6.	8.8	7.85	190	89	895

Table 7. Average of gonado-somatic index of maleand female *Puntius amphibious.*

Month	No. of males	G.S.I	No. of females	G.S.I
March	6	0.48	16	0.44
April	1	1.34	27	2.21
May	3	1.68	17	3.09
June	3	1.24	13	2.48
July	2	1.02	8	0.18
August	3	0.21	7	0.15

Feeding index of total fish population varies between months. Feeding intensity was maximum in August (40%) and minimum in April (21.13%). Occurrence of stomach in various degrees of fullness was observed between months (Table 3). The empty stomach was greater in April indicated the commencement of spawning period. Poor gut content was maximum in March. Medium filled gut content was observed in April and May. Good gut content in maximum was seen in March. The gastro-somatic index of female (2.58) and male (2.48) was high during May (Table. 4). It was low during June in both female (1.16) and male (1.17). The intensity of feeding in mature fish specified the dynamic feeding habit of fish during spawning.

The population of females outnumbered the males during all months (Table 5). The ratio between males and females was not constant and female dominated over males in percentage contribution. Maximum numbers of female were found in April and minimum were found in March.Similar observations was made by Mini (1996) in *Puntius amphibious* from Pamba River and pointed out that it may be due to the sexual segregation, selective migration, differential collection or perhaps genetic conditions. Jayaprakash (1980) also reported a female dominance in *Etroplussuratensis*.

The increase in number of eggs was proportional to the length of the fish. Difference was also attained in the fish of same length. Fecundity also increased with increase in the weight of the ovary (Table 6). But difference was also noticed in the fecundity of ovary with less weight. Monthly variation in gonado-somatic index of male and femalewas calculated (Table.7). The average gonado-somatic index of female (3.093) and male (1.680) was high during May. Gonado-somatic index was high in the breeding season and it will gradually decrease after breeding period. Mini (1996) observed that ripening fishes were present during the premonsoon and monsoon seasons. Also put forwarded that fishes in different stages of maturity overlapped with specific periodicity, thereby

suggesting the presence of a definite spawning season.

Length-weight relationship of *Puntius amphibius* revealed that there was no significant variation between males and females. Analysis of the gut content showed that it is aomnivore and phytoplankton formed the major food. Zooplankton formed a minor part of the gut content. Compositions of gut content divulged it is a selective feeder of Bacillariophyceae. Gastro-somatic index was high in May which coincided with the active feeding of mature fish during breeding period. Analysis of the sex ratio showed that females were outnumbered than the males. Fecundity was proportional to the weight of the ovary. Gonado-somatic index was high during monsoon season.

4. CONCLUSION

Growth of fish in same species in different geographical areas varies as it is subjective to quite a lot of biotic and abiotic factors. Information on the diet of fish is adequate in understanding its nutritional requirement and trophic correlation. Evaluation on reproductive biology brings about the view of adaptation of fish in a fluctuating environment to sustain a viable population. All these elements are to be taken into account for proper management of fish population.

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A NEW RECORD OF THE GENUS *CREPIDOTUS* (CREPIDOTACEAE, FUNGI) FROM INDIA

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ABSTRACT

A *Crepidotus* species, *C. cinnabarinus* is recorded for the first time from India. This species grow on decaying woody plant materials. It is characterized by small to medium sized, pleurotoid, flabelliform, laterally attached basidiomata with convex to applanate pileus. Spores are generally ovoid to subglobose without a germ- pore.

Keywords: Fungi, Agaricales, Crepiditaceae, *Crepidotus*, new records.

1. INTRODUCTION

During the study of Agaric flora of Northern Kerala, we came across a species belonging to the genus *Crepidotus*. It was found to be a new record from India. Manjula (1983) listed five species of *Crepidotus viz. C. Cystidiosus, C. eucalypticola, C. uber, C. applanatus and C. alveolus* as known from India. Of these, the first three were collected from Tamil Nadu state by Natarajan and Raman (1981) and later they (Natarajan and Raman, 1983) added two more species *C. applanatus and C. nephrodes* to the Indian records. Vrinda *et al.* (2000) reported two species, *C. citrinus,* and *C. pezizula* from Western Ghats. Mohanan (2011) added five species *viz. C. calolepis, C. epicrocinus, C. grumosopilosus, C. melleus* and *C. reversus* to the Indian records.

2. MATERIALS AND METHODS

Microscopic observations are made on materials mounted in 3% aqueous KOH. Colour codes refer to Kornerup and Wanscher (1978). The collected specimen is described, illustrated and discussed. Spore statistics are based on measurement of twenty spores.

2.1. Description of species

Crepidotus cinnabarinus Peck, Bull. Torrey Bot. Club 22:489 (1895).

Pileus 10-45mm diameter, pleurotoid, laterally attached, flabelliform, convex to applanate when seen from the side; surface tomato red (8C8), may leach out during rain and become light orange (6A4) or greyish orange (6B4), sparsely dotted with fine, appressed squamules especially towards the margin; margin entire, at times turning fissile, initially inrolled, becoming incurved or decurved, deeply and irregularly lobate when old. Context up to 3mm thick, white to orange white (5A2). Lamellae adnate, initially pale yellow (4A3) to pale orange (5A3), becoming light brown (6D4), subcrowded, up to 3mm wide, with lamellulae of different lengths; edge tomato red (8C8), finely torn under a lens. Stipe 10-20 × 4-7 mm, lateral, stout, solid; surface white, tomentose at base. Odour not distinctive. Spore-print light brown (6D4).

Spores 5-8 × 4-5.5 (6.14 ± 0.80 × 4.83±0.44) µm, ovoid to subglobose, yellowish brown, thin to slightly thick walled, warty punctuate, without a germ- pore. Basidia 21.5-29 × 5.5-8 µm, clavate, 4- or sometimes 2-spored; sterigmata upto 5.5 µm long. Lamella-edge sterile with crowded cheilocystidia. Cheilocystidia 13-80 × 5-14.5 µm, mostly ventricose-fusoid with long flexuose apices which are at times furcate, sometimes clavate, thin- or sometimes slightly thick- walled, with a light reddish brown plasmatic pigment and frequently with a fine, hyaline encrustation on the wall. Pleurocystidia scattered, occasional, similar to cheilocystidia in all aspects. Hymenophoral trama regular; hyphae 1.5-2.5µm wide, thin-walled, hyaline to pale yellow, at times finely encrusted. Pileal trama interwoven; hyphae 2-10.5 µm wide, almost thin walled, light yellow to hyaline. Pileipellis a disrupted cutis; hyphae 1.5-7µm wide, thin walled, with light reddish brown plasmatic pigment, at times with faint hyaline encrustations. Clamp-connexions absent. On the base of a decaying wood stump, in imbricate clusters, August to October. Specimens examined: India, Kerala State, Wayanad District, Ponkuzhy: 28 October 1999, A. Thomas T343; 31 October 1999, A. Thomas T343b; 25 August 2015, A. Thomas T343c.

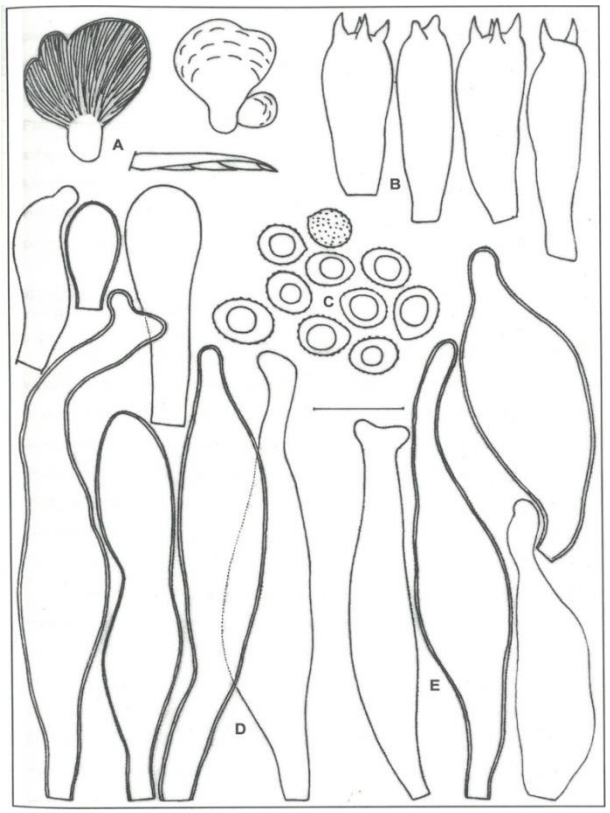

Fig. 1. ***Crepidotus cinnabarinus***
A. Habit; B. Basidia; C. Spores; D. Cheilocystidia; E. Pleurocystidia. Scale bar = 10 µm

Crepidotus cinnabarinus is characterized by the distinctive tomato red colour of the pileus and lamella- edge; ovoid to subglobose, warty-punctate spores; ventricose-fusoid cheilocystidia with reddish brown plasmatic pigment; non-gelatinized trama; and absence of clamp-connexions. In Singer's (1986) system, it will come under the section *Echinospori* Pilat, subsection *Aporpini* Singer. In Hesler and Smith's (1965) classification, it is placed in subgenus *Crepidotus*, section *Cinnabarini* Hesler and Smith where only *C. cinnabarinus* is known. The Kerala collections showed some minor deviations from that species which include larger and robust basidiomata; fine, hyaline encrustations on the cheilocystidia, tramal hyphae and pileipellis hyphae; and absence of Pileocystidia.

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PHYTOCHEMICAL ANALYSIS OF LEAVES OF TEAK (*TECTONA GRANDIS* L.F.) BY GC MS

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ABSTRACT

The timber value of *Tectona grandis*has been established from decades. Teak is an exotic species cultivated along most parts of tropical regions. Anthocyanins are natural colourants which have raised a growing demand due to their extensive range of colours, innocuous and beneficial health effects. Anthocyanins belong to large group of polyphenolics - flavonoids, which are secondary metabolites synthesized by higher plants. Despite the remarkable application of anthocyaninsin food, pharmaceutical and cosmetic industries, still it is not properly exploited. In the present study, the bioactive components of *Tectonagrandis*young leaves have been evaluated using Perkin-Elmer Gas chromatography-Mass spectrometry. GC-MS analysis revealed the existence of eleven compounds. 5,9-Methanobenzocycloocten-1(2H)-one,3,4,5,6,7,8,9,10-octahydro-5,10-dihydroxy-3,3,7,7,9-pentamethyl(76.02%) and 1-naphthalene carboxylic acid, 5-[2-(3-furanyl)ethyl]decahydro-1,4a-dimethyl-6-methylene-[1R-(1.alpha.,4a.)] (13.95%). Other compounds present in minor quantities were ledol(0.92%), 3-Buten-2-one,4-(2,6,6-trimethyl-1-cyclohexen-1-yl)orionone(0.49%),9,12,15 Octadecatrienoic acid, methyl ester, (Z,Z,Z)- or Linolenic acid methyl ester (0.82%), Phytol(0.69%), Cedran-diol, 8S,14- (0.60%), Lupeol (0.71%), 3-Methoxymethyl-2,5,5,8a-tetramethyl-6,7,8a-tetrahydro-5H-chromene (3.45%) and Retinol(1.27%). This is the first report of identification of active constituents from the young leaves of *Tectonagrandis.*

Keywords: GC-MS analysis, *Tectonagrandis*, Anthocyanin, Biological potentialities.

1. INTRODUCTION

Teak belongs to Verbenaceaeis known for the valuable timber and cultivated around the world. Teak is an exotic species dominated along the tropical regions like India and other South-East Asian countries.*Tectona grandis* is found adapted to variety of habitats and climatic conditions from arid areas with only 500 mm of rain per year to moist forests with up to 5,000 mm. Leaves of the teak are used for making Pellakaigatti, where batter is poured into the teak leaf and is steamed.This type of usage is found in the coastal district of Udupi in the Tulunadu region in South India. Teak leaves are used by the larvae of moths of the genus Endoclita and other Lepidoptera including Turnip moth for its development.

Anthocyanins are members of the flavonoid group of phytochemicals, which is predominant in most of the plants. Anthocyanins are exceptional natural pigments with range of colours from red to blue and medicinally potential health benefits via antioxidants. Apart from the antioxidant property they also possess anti-inflammatory, cardioprotective, hepatoprotective and anti-cancerous role. They are also found to be a perfect alternative of the synthetic food colourant and dye(Sujata and Bhaskar 2013). Anthocyanins are water-soluble vacuolar pigments that may appear as red, purple, or blue depending on pH. They also form glycosidated derivatives. The main anthocyanidin structure comprises an aromatic ring that contains oxygen, which is also bonded by carbon-carbon bond to third aromatic ring (Ananthaswamy *et al*., 2004). Diverse types of anthocyanins are reported in nature.

Extraction is an important step in the isolation, identification and use of anthocyanin compounds.There is no single and standard extraction method available universally. Fruits, vegetables and herbs can be ground, dried, or lyophilized, and some fresh plants can be soaked with subsequent solvent extraction to extract phenolic compounds (Merken and Beecher 2000). In the case of teak, anthocyanin can be extracted from the fresh leaves using methanol:HCl mixture. No literature available regarding the GC-MS analysis of young leaves of *Tectona grandis* and hence the present investigation is undertaken. The main objective of the present study is the extraction and quantification of anthocyanin from the young leaves

of teak and to analyze the various phytochemical constituents from the extract by GC MS analysis.

2. MATERIALS AND METHODS

2.1. Plant material

For the study fresh tender leaves of*Tectona grandis* were collected from the natural habitat of Thiruvananthapuram district, Kerala.

2.2. Estimation of anthocyanin content

1g leaf sample homogenized in 3ml methanol with 1% HCl and vortexed for 30 sec and kept in water bath at 60^{o} C for 20 min. The samples were vortexed twice during incubation. Subsequently, the sample was centrifuged at 10000 rpm for 10 min. The supernatant was transferred to 10 ml volumetric flask. The residue was again mixed with 3 ml of methanol. The supernatant was again centrifuged and combined with the previous supernatant and made up to 10ml. The final extract solution was kept at 0^{o}C for further analysis.

1ml of extract was taken and transferred to 10ml volumetric flask for preparing two dilutions of sample, one adjusted with KCl buffer, pH 1.0 and the other with sodium acetate buffer pH 4.5. These dilutions were equilibrated for 15 min. The absorbance of each dilutions was read at 510 and 700 nm against blank distilled water (Sutharut and Sudarat, 2012).

2.3. Plant sample extraction

The leaf powder (100 g) was extracted with methanol using Soxhlethot continuous extraction method. The extract was collected and evaporated to dryness by using rotary vacuo unit. The final residue thus obtained was then subjected to GC-MS analysis.

2.4. Gas chromatography – Mass spectrum (GC-MS) analysis

GC–MS analysis was carried out on a GC Clarus 500 Perkin Elmer system comprising a AOC-20i autosampler and gas chromatograph interfaced to a mass spectrometer (GC-MS) instrument employing the following conditions: column Elite-1 fused silica capillary column (330mm x 0.25mm ID x 1µm df, composed of 100% Dimethyl poly siloxane), operating in electron impact mode at 70 eV; helium (99.999%) was used as carrier gas at a constant flow of 1ml/min and an injection volume of 0.5µl was employed (split ratio of 10:1) injector temperature 250°C; ionsource temperature 280°C. The oven temperature was programmed from 110°C (isothermal for 2 min), with an increase of 10°C/min, to 200°C, then 5°C/min to 280°C, ending with a 9 min isothermal at 280°C. Mass spectra were taken at 70 eV; a scan interval of 0.5 seconds and fragments from 40 to 550 Da.

2.5. Identification of compounds

Interpretation of mass spectrum GC-MS was conducted using the database of National Institute Standard and Technology (NIST) having more than 62,000 patterns. The spectrum of the unknown component was compared with the spectrum of the known components stored in the NIST library. The name, molecular weight and structure of the components of the test materials were ascertained.

3. RESULTS AND DISCUSSION

3.1. Anthocyanin content

The anthocyanin was quantified according to the method of Sutharut and Sudarat, (2012). 35.2 mg/g anthocyanin was present in the fresh tender leaf tissue.

3.2. GC MS Analysis

The compounds present in the methanolic extract of *Tectona grandis* identified by GC MS analysis are shown in the Fig.1. A total of 11 compounds were obtained from the analysis and the active principles with their retention time (RT), molecular formula, and concentration (%) in the ethanol extract of *T. grandis* are presented in Table - 1.Of the 11 compounds obtained the most prevailing compounds were 5,9-Methanobenzocycloocten-1(2H)-one,3,4,5,6,7,8,9,10-octahydro-5,10-dihydroxy-3,3,7,7,9-pentamethyl(76.02%) and 1-naphthalenecarboxylic acid,5-[2-(3-furanyl)ethyl]decahydro-1,4a-dimethyl-6-methylene-[1R-(1.alpha.,4a.)] (13.95%). Other compounds present in minor quantities were Ledol(0.92%), 3-Buten-2-one,4-(2,6,6-trimethyl-1-cyclohexen-1-yl) or ionone (0.49%),9,12,15-Octadecatrienoic acid, methyl ester, (Z,Z,Z)- or Linolenic acid methyl ester (0.82%), Phytol(0.69%), Cedran-diol, 8S,14- (0.60%), Lupeol (0.71%), 3-Methoxymethyl-2,5,5,8a-tetramethyl-6,7,8a-tetrahydro-5H-chromene (3.45%) and Retinol (1.27%).

Among the phytochemicals identified, ledol is a poisonous sesquiterpene that can cause cramps, paralysis and delirium. Rita *et al*. (2008) reported the variation based on age and localities in the content of ledol in the shoot oil from Ledumpalustre. Ionone derivatives occur mainly in plants containing beta-carotene. They have been detected in a variety

of foods including raspberries, carrots, roasted almonds, fruits and herbs.Linolenic acid methyl ester is the precursor of jasmonic acid. Sermakkani and Thangapandian (2012) reported the biological activities of octadecatrienoic acid methyl ester as anti-inflammatory, insectifuge hypocholesterolemic, Cancer preventive, nematicide, hepatoprotective, antihistaminic, antieczemic, antiacne, 5-Alpha reductase inhibitor, antiandrogenic, antiarthritic, and anticoronaryfrom the methanol leaf extract of *Cassia italica*.

Lupeol is a pharmacologically active triterpenoid. The compound could possess potential antiporotzoal, anti-inflammatory, anti-tumour, cardioprotective, hepatoprotective, antimicrobial activity (Subban *et al*., 2011). Saratha *et al*. (2011) found out the potent bioactive compound, lupeol, from the latex of *Calotropis gigantean,* which is vastly used as ananti-inflammatory compound. The present study suggests the possible use of this plant for lupeol that helps and supports the pharmaceutical industry in drug formulation. In the review of Gallo and Sarachine (2009) demonstrates lupeol have shown to possess a range of folk and proven biological activities such as anti-neoplastic, anti-inflammatory, anti-hypertensive and anti-urolithiatic drugs.Cedran-diol,8S,14- is a sequiterpene alcohol which possess both anti-microbial and anti-inflammatory activities (Thanga *et al*., 2012).

Table 1. Components detected from *Tectona grandis* ethanolic leaf extract

S. No.	Compounds	Chemical formula	Retention time	Area (%)
1.	Ledol	$C_{15}H_{26}O$	22.803	0.92
2.	3-Buten-2-one,4-(2,6,6-trimethyl-1-cyclohexen-1-yl) or ionone	$C_{13}H_{20}O$	40.597	0.49
3.	Linolenic acid methyl ester 9,12,15-Octadecatrienoic acid, methyl ester, (Z,Z,Z)-	$C_{19}H_{32}O_2$	41.447	0.82
4.	Phytol	$C_{20}H_{40}O$	41.819	0.69
5.	Cedran-diol, 8S,14-	$C_{15}H_{26}O_2$	46.538	0.60
6.	Lupeol	$C_{30}H_{50}O$	47.705	0.71
7.	5,9-Methanobenzocycloocten-1(2H)-one,3,4,5,6,7,8,9,10-octahydro-5,10-dihydroxy-3,3,7,7,9-pentamethyl	$C_{18}H_{28}O$	49.063	76.02
8.	1-Naphthalenecarboxylic acid,5-[2-(3-furanyl)ethyl]decahydro-1,4a-dimethyl-6-methylene-[1R-(1.alpha.,4a.)]	$C_{20}H_{28}O_3$	50.585	13.95
.	3-Methoxymethyl-2,5,5,8a-tetramethyl-6,7,8a-tetrahydro-5H-chromene	$C_{15}H_{24}O_2$	51.004	3.45
10.	Retinol	$C_{20}H_{30}O$	53.625	1.27

Phytol is diterpene alcohol that can be used as a precursor for the manufacture of synthetic forms of vitamin E and vitamin k and also in fragrance industry and used in cosmetics, shampoos, soaps, cleaners and detergents. Thanga *et al*. (2012) detectedphytol from *Canscora perfoliata* is also found to be effective at different stages of arthritis. It is found to be effective as well as preventive against arthritis. The results show that reactive oxygen species scavengers such as phytol constitute another promising novel class of pharmaceutical for the treatment of rheumatoid arthritis and possibly other chronic inflammatory diseases.3-buten-2-one,4-(2,6,6-trimethyl-1-cyclohexen-1-yl) or iononederivatives occur mainly in plants containing beta-carotene. They have been detected in a variety of food including raspberries, carrots, roasted almonds, fruits and herbs. Keith *et al*. (2004) analysed the aroma ofcultivar Meeker red raspberry from Oregon and Washington by aroma extraction dilution analysis. From their analysis, they isolated 21 compounds had an equivalent odour impact and the major odour compound is ionone.Subban *et al*. (2011) identified phytol from the chloroform, petroleum ether and ethanol extract of the leaves of the *Memecylon umbellatum* and showed that the compound posses many medicinal values and can be used for various human ailments.

The biological potentialities and functional role of these major components present in the methanolic leaf extract of teak i.e.5,9-methanobenzocycloocten-1(2H)-one,3,4,5,6,7,8,9,10-octahydro-5,10-dihydroxy-3,3,7,7,9-pentamethyl and 1-naphthalenecarboxylic acid,5-[2-(3-

furanyl)ethyl]decahydro-1,4a-dimethyl-6-methylene-[1R-(1.alpha.,4a.)] are still unknown and unexploited.

4. CONCLUSION

This study confirms that the tender leaves of teak act as good source of anthocyanin components which possesses many pharmoacological potentialities. 11compounds have been identified from the ethanolic extract of leaves by Gas Chromatography and Mass Spectrometry analysis. Since the biological potentiality of the lead molecule in this plant extract is unknown further studies are warranted to isolate, purify the lead molecule and its therapeutic evaluation.

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VARIATIONS OF PROXIMAL COMPOSITION IN *PILEA MICROPHYLLA* (L.) LIEBM DUE TO DESICCATION AND REHYDRATION IMPACTS

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ABSTRACT

Water deficiency is the most significant abiotic stress factor for land plants. Most plants are unable to survive desiccation to the air dry state. There are however a few species from lower plant groups to flowering plants that tolerate desiccation known as resurrection plants. So, the present investigation was undertaken to study the biochemical changes in Pileamicrophylla against desiccation (1, 3, 5 and 7 days) and rehydration (30 min) stress. As an initial part of the study total sugar, protein and proline content were analyzed and showed a gradual decline during the stress periods. The SDS-PAGE analysis of protein indicated the disapperance of certain bands in the desiccated and rehydrated samples (7D) when compared to the control indicating the denaturation of proteins during stress. Similarly, the appearance of new bands (15kDa on 3D and 20 and 17kDa on the 5D) were noticed suggesting the formation of stress related proteins to tide over desiccation. The amount of free amino acids increased in P. microphylla, in pace with desiccation periods. Constitutive increase in the level of proline (the stress amino acid) accumulation is seen when compared with the control i.e., 6 fold higher than that of the control, after exposed to desiccation for 5 D. Increase in proline level relating to exposure time of desiccation stress suggests its role as osmolyte. Similarly, a reduction in chlorophyll level and an increase in carotenoid were also observed during stress. Decrease of total chlorophyll content was observed with duration of desiccation. The decrease in chlorophyll a and b was recovered during rehydration up to 5 D. Further studies are warranted at molecular level in terms of stress proteins and genes involved in desiccation tolerance in this plant.

Keywords: Desiccation, amino acids, SDA-PAGE, rehydration, osmolyte.

1. INTRODUCTION

Most of the crop plants are sensitive to desiccation or drought. Except a small group of vascular angiosperm plants, termed resurrection plants. They have evolved unique mechanisms of desiccation tolerance and thus can tolerate severe water loss, and mostly adjust their water content with the relative humidity in the environment. They have the unique ability to survive months to years without water, lose most of the free water in their vegetative tissues, fall into anabiosis and upon rewatering, quickly regain normal activity. Thus, they are fundamentally different from other drought tolerant plants such as succulents or ephemerals, which cope up with drought by maintaining higher steady state water potential or via a short life cycle, respectively. Desiccation tolerant plants may be subdivided into homoiochlorophyllous and poikilochlorophyllous types (Tuba *et al.,* 1998). During desiccation homoiochlorophyllous species retain their intact photosynthetic apparatus and chlorophyll content in a readily recoverable form, whereas in poikilochlorophyllous species desiccation results in the loss of chlorophyll, which must be resynthetized following rehydration.

The main goals of the present study are to delineate whether *Pileamicrophylla* display an oxidative burst in the time-course response to desiccation-rehydration and to elucidate the protective mechanisms underlying tolerance to drought. *Pileamicrophylla* (L.) Liebm. also known commonly as Artillery or Gun powder Plant. It is annual plant native to Floridaand belongs to the Urticaceae. The plant grows in extreme conditions of habitats. Direct sunlight causes the leaves to turn brown and fall off, so it prefers filtered light.

2. MATERIALS AND METHODS

2.1. Desiccation treatment

All the experimental *Pilea microphylla* samples were collected from the natural habitat. Before desiccation, the samples were fully hydrated. The samples were desiccated in a desiccator over PEG in a controlled environment chamber. The selected species were subjected to four different desiccation regimes 1 D, 3 D, 5 D and 7 D. After the desiccation exposure a set of desiccated

samples were subjected to rehydration for 30 min. The samples were divided into two groups: desiccated and desiccated subsequently rehydrated. Control plants were maintained in an optimal water conditions in each case during the whole experimental period.

2.2. Quantification of photosynthetic pigments

Total chlorophylls were estimated by the method of Chappelle *et al.* (1992). The homogenate as centrifuged at 3000 rpm for 5 min. The aliquots were made up to 3 ml by using 80% acetone and the absorbance was measured at 470, 648 and 664 nm spectrophotometrically against 80% acetone as blank.

2.3. Estimation of sugars

Sugar content of leaves was estimated by the method of Miller (1972).

2.4. Quantification of total free amino acids

Total free amino acids were determined using the method of Moore and Stein (1948). Free proline accumulation was determined using the method of Bates *et al.* (1973).

2.5. Estimation of soluble proteins

The soluble proteins were estimated by using the method of Lowry *et al.* (1951).

2.6. Polyacrylamide gel electrophoresis (PAGE)

Genei mini model slab gel apparatus was used to carry out PAGE following the method of Laemmli (1970) and Fairbanks *et al.* (1971).

3. RESULTS AND DISCUSSION

3.1. Photosynthetic pigments

3.1.1. Chlorophylls

The effect of desiccation and rehydration showed varied response on the chlorophyll content of *P. microphylla* as shown in Table 1. Decrease of total chlorophyll content was observed with increasing duration of desiccation. It showed that both chlorophyll *a* and *b* decreased and consequently affected chlorophyll *a+b*and *a/b* ratio and recovered or showed some recovery during rehydration up to 5 D desiccated plant body.

Plants employ chlorophylls *a* and *b* and carotenoids to capture light for photosynthesis. Most of the pigments serve as an antenna complex and are involved in collecting and transferring light energy to the reaction centres, where chemical reactions occur. Chlorophyll *b* is mainly involved in light harvesting and thus is predominantly found in the chlorophyll *a/b* antenna proteins, whereas chlorophyll *a* is closely associated with the reaction centre complexes (Georgieva *et al.,* 2010). Carotenoids are associated with both antenna and reaction centre proteins, and have multiple functions in photosynthesis. Carotenoids play vital role by masking the chloroplast from photo-oxidative damage caused by high intensity of light. Xanthophylls can achieve photo-protection by quenching the excited state of chlorophyll harmlessly as heat (non-photochemical quenching) as well as scavenging any singlet oxygen, which might have been formed (Oliver *et al.,* 2005). Concentrations and ratios of photosynthetic pigments, (i.e., chlorophyll *a* and *b*, and carotenoids) are correlated to the irradiance experienced by plants in their natural habitat.

Plants that grow in low light often have greater amounts of chlorophyll *b* and lead to reduced chlorophyll *a* to *b* ratio than plants from high irradiance sites, possibly to increase light capture efficiency (Anderson, 1986). Similarly, higher chlorophyll to carotenoid ratios in plants from shaded habitats when compared with species from well-lit environments, suggests a lesser need for photo-protection. Lower resurrection plants have high levels of light harvesting chlorophyll *a/b* antenna protein complexes in comparison to vascular plants, suggesting shade acclimation (Beer *et al.,* 2002).

The decrease in Chl*a+b* content was mainly attributed to the destruction of Chl*b*, which is more sensitive to stress than Chl*a* (Ma *et al.,* 1997b). The desiccation stress can contribute a decrease in total chlorophyll content of the plant, by increasing the activity of Chl degrading enzyme cholorophyllase (Rao and Rao, 1981), inducing the destruction of chloroplast structure and instability of pigment protein complexes (Singh and Dubey, 1995). Results obtained from this study indicate that chlorophyll *b* is more susceptible to stress than chlorophyll *a* and it will be an ideal marker of drought stress.

3.1.2. Carotenoids

Carotenoid content was gently elevated by desiccation and attained the maximum value on 5 D. This is another indication for antioxidant potential in plants. Compared to the corresponding control, carotenoid contents increased by desiccation in *P. microphylla*(Table 1). The photosynthetic apparatus in *Pileamicrophylla*may be better protected from photo-damage.

Carotenoids protect plants against photo-oxidation, by effectively quenching the excited triplet state of chlorophyll and singlet oxygen. Protection of the photosynthetic apparatus from excess light absorption requires carotenoids (oxygenated) (Horton *et al.,* 1996). Similar to other resurrection plants, *P. microphylla* inhabit areas with high irradiances usually have a better developed photo-protective system, illustrated by its chlorophyll to carotenoid ratios (Marschall *et al.,* 2004).

Pileamicrophylla studied here have acclimated to the levels of light available, within their habitat. Flowering plants from habitats with low radiation inputs had higher concentrations of photosynthetic pigments (i.e., chlorophyll and carotenoids) and higher chlorophyll to carotenoid ratios, than from sunny environments. Plants from shaded environments usually modify chlorophyll *a/b* protein complexes to increase light harvesting, illustrated by a low chlorophyll *a* to *b* ratio (Leong *et al.,* 1983).

This species had reduction in the amounts of photosynthetic pigments and chlorophyll *a* to *b* ratio (Table 1). This illustrates the need for an efficient light harvesting system, to collect all of the available light. The values are in accordance with other species, from extremely shaded environments (Marschall*et al.,* 2004). The chloroplast distribution in such plantsshowed some remarkable features. The ventral side of the lamina is unlikely to be exposed to light, yet chloroplasts were found there. Such a feature could afford protection from environmental stress, since it allows preservation of functional chloroplasts on the ventral side, while the chloroplasts on the dorsal side are being damaged.

3.1.3. Total soluble sugar

In *P. microphylla* the level of sugar showed gradual decline from 1 D of desiccation onwards indicating the depletion of stored carbohydrates into soluble sugars and its consumption (Table 2). Plants accumulate carbohydrates such as starch and fructans as storage substances that can be mobilized during periods of limited energy supply or enhanced energetic demands. While most plant species use starch as their main storage carbohydrate, several angiosperms, mainly from regions with seasonal cold and dry periods, accumulate fructans (Hendry, 1993). Accumulation of fructans might be advantageous, due to their high water solubility, their resistance to crystallization at freezing temperatures, and the fact that fructan synthesis functions normally under low temperatures (Livingston *et al.*, 2009). Furthermore, fructans can stabilize membranes and might indirectly contribute to osmotic adjustment upon freezing and dehydration by the release of hexose sugars (Spollen and Nelson, 1994; Olien and Clark, 1995). Many researchers like Basu *et al.* (2007); Kempa *et al.* (2008) has reported that salt and drought stress generally leads to a depletion of starch content and to the accumulation of soluble sugars in leaves. Sugars that accumulate in response to stress can function as osmolytes to maintain cell turgor and have the ability to protect membranes and proteins from stress damage (Kaplan and Guy, 2004).

3.1.4. Total Soluble protein

Soluble protein decreased significantly in both desiccated and also rehydrated plants that are imposed to stress (Table 3). Protein degradation might be the result of increased activity of protease or other catabolic enzymes, which were activated under desiccation stress, or due to fragmentation of proteins by the toxic effects of ROS resulting in reduced protein content (Davies, 1987). A decrease in the protein concentration would be a typical symptom of oxidative stress and has frequently been observed in drought stressed plants (Moran *et al.,* 1994)

3.1.5. Total free amino acids and proline content

Total free amino acids and proline contents in *P.microphylla* are shown in the Table 4. The amount of free amino acids increased in *P. microphylla*, in pace with desiccation periods. Although the total amino acids are clearly built up in the species, their accumulation is more obvious during 5D of desiccation. Constitutive level of proline accumulation is also increased when compared with the control i.e., 6 fold higher than that of the control, after exposed to desiccation for 5 D. The proline content progressively enhanced, corresponding to desiccation period up to 5D. Increase in proline level relating to exposure time of desiccation stress suggests its role as osmolyte. The long exposure period (7 D) reduced the proline accumulation. There are three possible reasons for the free proline accumulation under stress- (1) stimulation of proline synthesis from glutamic acid (Girousse*et al.,* 1996), which has been found to be dependent on the abscisic acid concentration; (2) inhibition of proline oxidation to other soluble compounds; (3) inhibition of protein synthesis. In contrast to its metabolism, the physiological significance of proline accumulation has been less studied (Sharma *et al.,* 2006).

Table 1. Chlorophyll a, b and carotenoid content (mg g^{-1} FW) of the desiccated (1, 3, 5 and 7 D) and rehydrated plant body of *P. microphylla.* Data points represent means of three replicates and probability level at *P*<0.01.

Pigments	Control	1 D	1 R	3 D	3 R	5 D	5 R	7 D	7 R
Chl a	4.2	2.98	3.6	2.26	3.72	1.92	3.67	1.8	2.56
SE	0.96	0.54	0.26	0.27	0.19	0.31	0.26	0.21	0.32
Chl b	1.79	1.73	1.4	1.13	1.52	1.0	1.38	0.92	0.99
SE	0.57	0.55	0.50	0.47	0.56	0.51	0.45	0.44	0.33
Caro	0.80	1.1	1.0	1.2	1.0	1.2	0.98	0.64	0.73
SE	0.90	0.49	0.28	0.57	0.49	0.39	0.50	0.31	0.58
F ratio	1.96**	7.8**	12.6**	14.9**	10.8**	8.9**	7.6**	3.9**	4.8**
CD	1.3	1.4	1.28	1.39	1.46	1.38	1.52	1.28	1.34

Table 2. Influence of desiccation (1, 3, 5 and 7 D; D=days) and rehydration on the levels of total sugar content (µg/g). The values are means of three individual experiments with duplicates and probability level at *P*<0.01.

Condition	1 D	3 D	5 D	7D
Control	21.11	19.89	20.67	21.68
SE	2.34	1.21	1.08	1.22
Desiccation	13.17	10.76	6.96	4.6
SE	1.42	1.08	1.07	0.28
Rehydration	17.2	16.04	12.83	12.5
SE	1.04	1.26	1.31	0.78
F ratio	2.85**	3.52**	3.69**	4.85**
CD	1.08	1.24	1.32	1.09

Table 3. Influence of desiccation (1, 3, 5 and 7 D; D=days) and rehydration on the levels of total protein content (mg/g). The values are means of three individual experiments with duplicates and probability level at *P*<0.01.

Condition	1 D	3 D	5 D	7 D
Control	8.97	7.89	8.25	8.55
SE	1.24	0.66	0.92	1.00
Desiccation	6.2	4.3	3.24	1.87
SE	0.08	0.16	0.24	0.13
Rehydration	7.02	8.19	5.74	4.80
SE	1.24	0.29	1.01	0.76
F ratio	1.29**	1.69**	1.99**	2.78**
CD	1.07	0.98	0.29	1.08

Table 4. Free amino acids, Proline, content of the desiccated (1, 3, 5 and 7 D) and rehydrated plant body of *P.microphylla*. Data points represent means of three replicates and probability level at *P*<0.01

	Control	1 D	1 R	3 D	3 R	5 D	5 R	7 D	7 R
Free amino acids (µg g^{-1} FW)	1.76	4.85	2.1	8.78	2.4	9.69	2.5	8.2	2.6
SE	0.06	0.08	0.04	0.09	0.06	0.07	0.02	0.04	0.08
F ratio	1.3**	1.4**	1.7**	1.9**	1.2**	1.49**	1.8**	1.98**	1.29**
CD	1.03	1.25	1.39	1.21	1.08	1.77	1.67	1.58	1.49
Proline (µg g^{-1} FW)	175.5	323	180.6	556	184.6	1038	190.3	696.5	190.6
SE	0.13	0.29	0.66	0.49	0.78	0.92	0.81	0.67	0.77
F ratio	1.6**	2.4**	1.38**	1.39**	1.66**	1.69**	1.28**	1.39**	1.45**
CD	1.25	1.38	1.42	1.08	1.29	1.65	1.89	1.29	1.66

In halophytes, salt tolerance associates with the capacity to accumulate proline, which acts as compatible solute, involved in osmotic adjustment at the plant cell level (Delauney*et al.,* 1993). It has been suggested that, the proline accumulation is due primarily to the function of both genes encoding Δ^1-pyrroline-5-carboxylate reductase, and Δ^1-pyrroline-5-carboxylate synthetase (Delauney*et al.,* 1993). Eder *et al.* (1977) reported that decreased protein synthesis and/or increased protein hydrolysis in pearl millet seedling by salinity, could lead to the accumulation of free amino acids and proline. In the present study, proline accumulation is observed in *P. Microphylla*(Table 4). However, at higher duration of desiccation (above 5D) the plantwilted; this suggests that proline does not help in reducing dehydration damage in this species. Another compatible solute, glycine betaine also functions as an important osmoprotectant between the cytoplasm and vacuole (Chen *et al.,* 2002). Furthermore, this compound can reduce lipid peroxidation and protect mitochondrial electron transport reactions from stress damage (Chen *et al.,* 2002). Previous studies have reported that, increased glycine betaine contributed to overcome water and salt stress in leguminous plants (Girija*et al.,* 2002). For a better understanding of the role of this compatible solute in osmotic maintenance in *P. microphylla*, further studies are warranted.

The free amino acid content has been shown to increase under drought conditions in sorghum (Yadav *et al.,* 2005). Similar results were obtained in pepper (Nath*et al.,* 2005), coconut (Kasturibai*et al.,* 2000), wheat (Hamada, 2000) and ground nut (Asha *et al.,* 2002). Free amino acid accumulation is more important to account for most of the changes in osmotic potential. The accumulation of free amino acids under stress at all the experimental species indicates the possibility of their involvement in osmotic adjustment (Yadav *et al.,* 2005). Osmotic adjustment is one of the important mechanisms alleviating some of the detrimental effects of water stress (Morgan, 1984).

Similarly, increased proline accumulation was reported in water stressed sorghum (Yadav *et al.,* 2005), bell pepper (Nath*et al.,* 2005), wheat (Hamada, 2000) and in salt stressed *Catharanthusroseus*(Jaleel *et al.,* 2007c). Increased proline in the stressed plants may be an adaptation to overcome the stress conditions. Proline accumulates under stressed conditions supplies energy for growth and survival and thereby helps the plant to tolerate stress (Chandrashekar*et al.,* 1996). Under abiotic stress like UV light the proline content showed an increase in wheat (Demir, 2000). NaCl stress showed increased proline content in rice (Lin *et al.,* 2002) and peanut (Girija*et al.,* 2002). Proline accumulation in plants might have a scavenger role of ROS and also act as an osmolyte (Tripathi and Gaur, 2004). The reduced proline oxidase may be another reason for increasing proline accumulation. Many researchers suggested that, proline plays a pivotal role in imparting plants tolerance to stress that lower the water potential of ambient environment.

Abiotic stresses like salt, heavy metals/drought lead to an increased accumulation of proline in tobacco cells coupled with the γ-glutamyl kinase level (Larosa*et al.,* 1991). So the induction of proline accumulation, in the present study is may be due to an activation of proline synthesis through the glutamate pathway involving γ-glutamyl kinase, glutamyl phosphate reductase and Δ^1–pyrroline-5-carboxylate reductase activities (Bray, 1990; Girija*et al.,* 2002; Fujita *et al.,* 2003). The proline accumulation in desiccation-stressed bryophytes may be attributed to the increased level of γ-glutamyl kinase activity or decreased level of proline metabolizing enzymes, like proline oxidase. The present study coincides with earlier reports concerning water stress in plants (Fujita *et al.,* 2003).

3.1.6. Polypeptide banding pattern in SDS-PAGE

Environmental stress affects the protein banding pattern to counteract the stress. In the present study, the desiccation tolerance nature of *P. microphylla* was also evaluated using SDS-PAGE (Fig. 1). On the 1 D of desiccation 6 protein bands were formed with molecular mass of 38, 36, 28, 21, 15 and 12 kDa. While on rehydration for 30 mins in the 1 D desiccated plant showed the disappearance of the 15 kDa band and appearance of a new faint band at 60 kDa. Similar studies have been undertaken by earlier workers. Under stress condition the plant synthesize the heat shock proteins. The essential function of heat shock proteins is preventing aggregation and assisting refolding of non-active proteins under both normal and stress conditions (Hartl, 1996; Frydman, 2001).

In the 3 D desiccated plants only 3 bands were noticed i.e., an intensified 15 kDa band and new bands of 10 and 5 kDa. Meanwhile in the rehydrated plant along with the above 3 bands, 3 new bands at 21, 24 and 32 kDa were observed.

In contrast to the above results, the 5 D

desiccated plants showed only two intensified bands at 20 and 17 kDa. The rehydrated plants along with above bands showed two faint bands at 15 and 10 kDa. Ali and Basha (1998) showed that the total protein content of the leaves significantly increased when peanut plants were subjected to water stress for 5 to 20 as compared to irrigated controls.

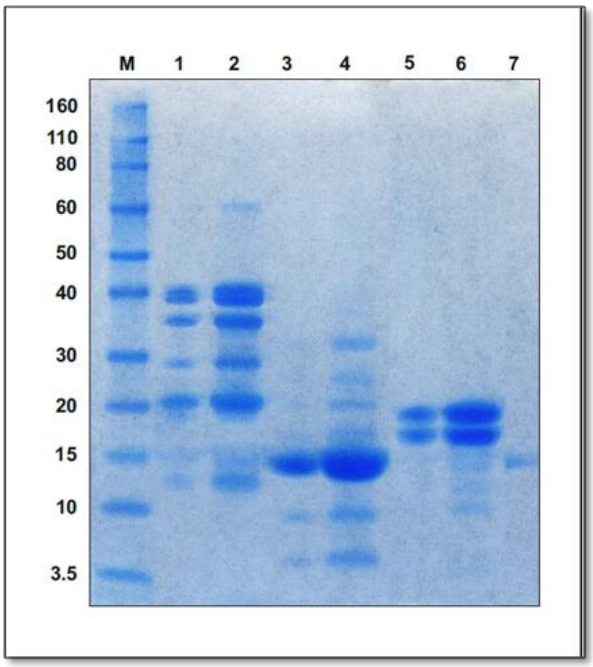

Fig .1 Protein banding pattern in *P. Microphylla* under different regimes of desiccation

M- Marker; (1) 1 D desiccated; (2) 1 D rehydrated; (3) 3 D desiccated; (4) 3 D rehydrated; (5) 5 D desiccated; (6) 5 D rehydrated; (7) 7 D desiccated

The 7 D desiccated plant generated only a single faint band at 15 kda. Interestingly the rehydrated plant showed no bands indicating the limitation of the species to drought stress i.e., maximum tolerance is up to 5 D of desiccation. Similarly, Jyotiranjan rout *et al.,* 2012 reported that in response to iron stress in *Withaniasomnifera L*. the SDS-PAGE profile showed a significant increase of protein content in leaves and roots up to a certain limit and then decreased.

4. CONCLUSION

This study has presented evidence that, *P. microphylla* are equipped to deal with abiotic stress–desiccation and subsequent rehydration environments up to 5 D. Changes in pigment composition and chloroplast thylakoids remained intact or distorted throughout the course of desiccation but regained during rehydration. Further studies are warrented for the characterization of stress related proteins.

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ANTIMICROBIAL ACTIVITIES AND PHYTOCHEMICAL INVESTIGATION OF FERN, *LYGODIUM FLEXUOSUM* (LINN) SW.

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ABSTRACT

The present study revealed the presence of many medicinally active constituent in *Lygodium flexuosum,* suggesting that this species have potential to synthesize useful secondary metabolites. In this studies two different types (vegetative material and sporophyll bearing type) of this species showed the presence of secondary metabolites such as alkaloids, flavonoids, saponins, tannins, phenols and glycosides. In which vegetative material showed the presence of all secondary metabolites. The low polar solvent extracts such as petroleum ether and acetone showed minimum presence of secondary metabolites. The antibacterial studies revealed that methanol extracts of sporophyll type exhibited significant activity (8.5 mm) against the bacterium, *Klebsiella pneumonia.* The next antibacterial activity showed by chloroform extracts of sporophyll type against the same bacteria (8.2 mm). In antifungal studies, methanol extracts of vegetative material has the highest inhibitory activity (19.3 mm) against the fungus *Cladosporium* sp. Next higher fungal activity was showed by same extract of sporophyll type against the fungus *Rhizopus* sp. (16.08 mm). The study confirms the antimicrobial potential of *Lygodium flexuosum* extracted using various solvents.

Keywords: Secondary metabolites, potential, phytochemical analysis, antimicrobial.

1. INTRODUCTION

Plants have been used for the treatment of diseases all over the world before the advent of modern clinical drugs. Humans have been dependent upon the plants as an important source of medicine since ancient times. Very small portion of Indian medicinal plants belongs to lower groups. Medicinal value of the ferns have been known to man for more than 2000 years, they have been found with very little application in modern chemotherapy as compared to the angiosperms. In India, total fern species were 1022, they have been recorded with respect to vast angiospermic diversity (15000 species) in that ferns plants played a significant role in ethno-medicine. In ancient Indian medicine several ferns were used, and in particular by Unani physicians in India and Western Asia. Reports showed that ferns were used by the people of India and in various other countries. Most of the diseases against which the lycophytes are said to have curative properties, are caused by bacteria (gram-positive, gram- negative or acid-fast). A systematic survey of the antibiotic activity of the ferns, however, has been scarcely undertaken (Banerjee and Sen, 1980). In most cases the antimicrobial activities of few ferns were being screened.

The screening of plant extracts of pteridophytes has been of great interest to scientists for the discovery of new drugs effective in the treatment of several diseases. *Lygodium flexuosum* (Lygodinaceae) is an epiphytic plant which is medicinally very important. The rhizome and root is useful in the treatment of jaundice. Leaf extract had antiproliferative and apoptotic activity in cancer cells. This fern is reported to exhibit antiferility activity. Extract of rhizome of is used to cure gonorrhoea. The ash of the plant is used for treating herps. This plant is also used to feed domestic animals to treat foot and mouth diseases (Wills and Asha, 2006a and 2006b). In this study an attempt was made to analyse the preliminary phytochemistry and antimicrobial activities of *Lygodium flexuosum* (vegetative material and sporophyll type).

2. MATERIALS AND METHODS

2.1. Collection of plant materials

For the present study of phytochemical analysis, powdered material of whole plant was used. The clean and healthy individuals of vegetative material and sporophyll bearing types were collected from in an around the Sree Narayana College, Kannur and they were shade dried separately.

2.2. Preparation of plant extracts

To know the presence of major phytochemicals, the shade dried plants of two different types individuals (vegetative material and sporophyll bearing) were made into a fine powder of 40 mesh size using the pulverizer separately. Following that, 100 g of the powder was weighed and successively extracted using 150 ml solvents *viz.* petroleum ether, acetone, chloroform and finally with methanol using the rotary shaker for 10 days (Gafner *et al*., 1985). The extract was filtered through Whatman No.1 filter paper to remove all undissolved matter, including cellular materials and other constituents that are insoluble in the extraction solvents.

2.3. Preliminary phytochemical analysis

Preliminary phytochemical testing for the presence of various compounds were analysed by using standard method of procedure.

2.3.1. Test for alkaloids (Ciulci, 1994)

To 1 ml of each extract in two separate test tubes, 2-3 drops of Dragendorff's and Meyer's reagents were separately added. An orange red precipitate/turbidity with Dragendorff's reagent or white precipitate with Meyer's reagent would indicate the presence of alkaloids.

2.3.2. Test for flavonoids (Sofowara, 1993)

To 4 ml of each of the extracts, a piece of magnesium ribbon was added followed by concentrated HCl drop wise. A colour ranging from crimson to magenta indicated the presence of flavonoids.

2.3.3. Test for glycosides (Gokhale, et al., 2008)

Keller Kiliani test: To the 2 ml of extracts, 1ml of glacial acetic acid with ferric chloride and concentrated sulphuric acid is added. The appearance of blue colour indicates the presence of glycosides.

2.3.4. Test for saponins (Brain and Turner, 1975)

One ml of extract was taken in a test tube and 5 ml of distilled water was added and vigorously shaken. A persistent froth that lasted for at least 15 minutes indicated the presence of saponins.

2.3.5. Test for tannins (Mace and Gorbach, 1963; Ciulci, 1994)

Two ml of the extracts were diluted with distilled water in separate test tubes and 2-3 drops of 5 % ferric chloride ($Fecl_3$) solution was added. A green-black or blue-black colouration indicated the presence of tannins.

2.3.6. Test for phenols (Krishnamoorthy, 1988)

Five ml of the concentrated extracts were taken and 2ml of neutral ferric chloride solution was added. Appearance of violet colour indicates the presence of phenols.

2.4. Antimicrobial studies

For antimicrobial studies, three bacterial strains *viz., Escherichia coli , Klebsiella pneumonia* and *Proteus mirabilis* and four fungal strains *viz*., *Aspergillus flavus, Penicillium* sp., *Cladosporium* sp., and *Rhizopus* sp. were used which have been obtained from the Department of Microbiology, Sree Narayana College, Kannur. The above mentioned bacterial and fungal strains were grown in nutrient agar medium and potato dextrose agar medium respectively. The different extracts of three different species were tested for antimicrobial activity by following disc diffusion method (Bauer *et al.,* 1966). The antibiotic disc tetracycline (30µg) was taken as positive control. Triplicates were maintained for all extracts of three species. The antimicrobial assay plates were incubated at 37°C for 24h. The diameters of the inhibition zones were measured.

3. RESULTS

Plants are recognized for their ability to produce a wealth of secondary metabolites, extensively used for traditional medicine for centuries to treat a variety of disease. Secondary metabolites in plant products are responsible for several biological activities in living systems. Antimicrobial properties of several plant extracts have been attributed due to the secondary metabolites (Jaiganesh and Arunachalamb, 2011). Pharmaceutical and scientific communities have recently received the attention of the medicinal plants, and various publications have documented the therapeutic worth of natural compounds to validate the claims of their biological activity (Bauer *et al.,* 1966).

Table 1. Result of preliminary phytochemical analysis of *Lygodium flexuosum* (vegetative material).

Extract	Secondary metabolites					
	Alkaloids	Flavonoids	Glycosides	Saponins	Tannins	Phenols
P	+	-	+	-	+	-
A	+	-	++	+	++	-
C	-	-	+++	-	+	-
M	+	++	+	+	+	++

\+ very less ++ medium +++ high - absent
P- Petroleum ether; A – Acetone; C – Chloroform; M - Methanol

In the present study of preliminary phytochemical analysis, the crude extracts of whole plant body of *Lygodium flexuosum* showed diverse phytoprofiles with reference to different solvents. The results of phytochemical analysis of vegetative material and sporophyll types of the plant species are represented in Table 1 and 2. Among the four solvents used methanol extract showed the presence of secondary metabolites such as alkaloids, saponins, tannins, phenols, glycosides and flavonoids. While comparing the results of the preliminary phytochemical analysis, vegetative material of the species showed presence all the secondary metabolites.

Table 2. Result of preliminary phytochemical analysis of *Lygodium flexuosum* (sporophyll).

Extracts	Secondary metabolites					
	Alkaloids	Flavonoids	Glycosides	Saponins	Tannins	Phenol
P	+	-	++	-	+	-
A	+	-	+	+	+++	-
C	-	-	++	-	+++	-
M	++	++	+	+	+++	-

+ very less ++ medium +++ high - absent
P- Petroleum ether; A – Acetone; C – Chloroform; M - Methanol

In the two study material of the species, alkaloids shows its presence in petroleum ether, acetone and methanol. In which maximum presence was shown by methanol extract of sporophyll type. Flavonoid compounds are present in methanol extracts of two different types. In all other low polar solvents this secondary metabolite is absent. Glycosides are present in almost all extracts of two different types this species. In which chloroform extracts shows maximum content of glycosides. Saponins are represented by acetone and methanol extracts of vegetative material and sporophyll types at its minimum level. In all other extracts they are absent. Tannins are represented almost all extracts of two different types of this species. In which the sporophyll type shows maximum result in acetone, choloroform and methanol extracts. Phenols showed their presence only in the vegetative material of methanol extracts. In sporophyll type, this compound is completely absent.

The antibacterial activity of *Lygodium flexuosum* were assayed *invitro* by agar disc diffusion method against three bacterial species (Table 3). The result of the study reveals that methanol extract of sporophyll type exhibited significant activity (8.5 mm) against the bacterium *Klebsiella pneumonia*. The next higher bacterial activity is showed by chloroform extract of sporophyll type against the bacterium *Klebsiella pneumonia* (8.2 mm). On the other hand acetone extract of vegetative material showed very less activity against the bacteria *Klebsiella pneumonia* (5.0 mm).

Table 3. Antimicrobial activity of plant extracts of *Lygodium flexuosum* (vegetative material).

Plant extract	Concentration	Diameter of inhibition zone(mm)						
		Bacteria			Fungi			
		Escherichia coli	*Klebsiella pneumonia*	*Proteus mirabilis*	*Aspergillus flavus*	*Penicillium* sp.	*Cladosporium* sp.	*Rhizopus* sp.
Petroleum ether	C*	6.0±0.10	6.0±0.10	6.0±0.10	6.1±0.08	6.5±0.08	6.0±0.01	6.1±0.08
	100	5.2±0.02	5.1±0.04	5.1±0.01	5.5±0.06	5.12±0.07	5.2±0.01	10.12±0.07
Acetone	C*	6.1±0.2	6.0±0.10	6.0±0.10	6.0±0.10	7.3±0.11	7.5±0.06	6.08±0.12
	100	5.1±0.2	5.0±0.2	5.12±0.07	7.13±0.01	12.0±0.17	7.06±0.04	16.06±0.24
Chloroform	C*	6.01±0.2	6.0±0.10	6.03±0.2	6.1±0.5	7.06±0.08	7.56±0.02	6.09±0.55
	100	5.3±0.02	5.2±0.02	5.1±0.02	5.31±0.02	8.16±0.03	7.3±0.06	11.56±0.04
Methanol	C*	6.01±0.2	6.0±0.10	10.2±0.04	7.16±0.04	7.46±0.34	7.10±0.01	7.2±0.11
	100	5.3±0.02	5.1±0.10	7.12±0.06	5.13±0.02	11.06±0.04	19.3±0.06	12.06±0.04

Table 4. Antimicrobial activity of plant extracts of *Lygodium flexuosum* (sporophyll).

Plant extract	Concentration	Diameter of inhibition zone(mm)						
		Bacteria			Fungi			
		Escherichia coli	*Klebsiella pneumonia*	*Proteus mirabilis*	*Aspergillus flavus*	*Penicillium* sp.	*Cladosporium* sp.	*Rhizopus* sp.
Petroleum ether	C*	6.05±0.11	6.02±0.50	6.12±0.13	6.2±0.08	6.5±0.08	6.6±0.15	6.1±0.08
	100	5.12±0.02	5.15±0.04	5.10±0.04	5.5±0.06	5.11±0.17	5.2±0.11	7.12±0.07
Acetone	C*	6.1±0.17	6.4±0.8	6.0±0.14	6.0±0.18	7.13±0.09	7.5±0.55	6.38±0.17
	100	7.15±0.2	6.0±0.23	6.12±0.08	5.43±0.01	10.07±0.65	10.06±0.04	6.06±0.2
Chloroform	C*	6.11±0.12	6.47±0.07	6.8±0.22	6.6±0.5	7.96±0.18	7.50±0.08	6.30±0.51
	100	7.13±0.02	8.20±0.22	6.61±0.02	5.33±0.22	6.16±0.33	9.30±0.05	14.56±0.12
Methanol	C*	6.11±0.21	6.4±0.33	10.2±0.51	7.11±0.14	7.16±0.74	7.18±0.11	7.22±0.13
	100	6.3±0.22	8.5±0.16	7.10±0.08	5.33±0.22	12.56±0.05	15.3±0.56	16.08±0.44

The antifungal activities of four different extracts of *Lygodium flexuosum* against four fungal strains are given in the Table 4 (Fig. 3). The result of the studies states that methanol extract of vegetative material has the highest inhibitory activity (19.3 mm) against the fungus *Cladosporium* sp. Next higher fungal activity was shown by methanol extract of sporophyll type against the *Rhizopus* sp. (16.08 mm). On the other hand petroleum ether extract of both the type shows very less activity against the fungus *Cladosporium* sp. (5.2 mm).

4. DISCUSSION

The tribal communities, ethnic groups and folklore throughout the world are utilizing pteridophyte plant parts like rhizome, stem, fronds, pinnae and spores in various ways for the treatment of ailments since ancient time (Kumar and Kushik, 1999). The medicinal value is caused by presence of chemical compounds in ferns. Hence this study is focused to analyse the compounds which are present in our study plant species, *Lygodium flexuosum* with four different solvent extracts. Maximum number of compounds were screened in methanol extract. Alkaloids and flavonoids are considered as the source of antimicrobial activity. In this research work alkaloids are present in all most all extracts but flavonoids are present only in methanol extract. Tannins are also represent in almost all extracts of two different type of this species which have potential value as cytotoxic agent (Aguinaldo *et al*., 2005). So this plant can be used as an anticancer agent. Phenolic compounds are important source of antimicrobial and insecticidal activities. But phenol showed their presence only in the methanol extracts of vegetative material of this species. Saponins and glycosides has been implicated as bioactive antibacterial agents (Mandal *et al.,* 2005). Saponins are represented by acetone and methanol extract of two different types at its minimum level. Glycosides are present in almost all extract of two different types of this species. Glycosides are considered as a class of molecules which play crucial roles in combating a number of dreadful diseases especially heart diseases. Thus our study also leads to the further research in the way of isolation and identification of active compounds.

In the present investigation, *in vitro* antimicrobial efficiency of two types of *Lygodium flexuosum*, was quantitatively assessed on the basis of zone of inhibition. In this two different types studied the present investigation exhibited varying degree of inhibitory effect against the selected microbial pathogens. Eloff (1998) reported that methanol was the most effective solvent for plant extraction than chloroform, acetone and petroleum ether. Our studies confirmed the Eloff observation with maximum activity. The present study indicates antimicrobial property of the plant against the selected strains of pathogenic microbes varies depends upon the solvent medium used for extraction.

The inhibitory activity was higher for the extracts of high polar solvent like methanol. It may be attributed to higher polarity of the solvents which naturally have high degree of extracting capacity (Aiyelaagbe *et al.,* 2007). Raskin *et al*. (2002) pointed out that more than one compound in the crude extract might result in improved efficiency due to their synergetic effect.

5. CONCLUSION

The results obtained in this plant concluded that the antimicrobial property plays an important role in the identification of therapeutically potent bioactive compounds. This exploration on plant-derived antimicrobials was carried out to determine the identification of antimicrobial compounds within this plant and also to determine their full spectrum of efficacy.

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A COMPARATIVE ANATOMICAL CHARACTERISTICS OF THE STEMS OF CLIMBING PLANTS IN ARALAM WILD LEFE SANCTUARY, KANNUR

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ABSTRACT

Climbing plants differ from self-supporting plants, such as shrubs and trees, in a range of characteristics. The most notable is the mechanical properties of the stem Comparison of the differentiated anatomical structures recorded in ten species of the climbing plants. The plants selected for the present study are *Ampelocissus latifolia,*(Vitaceae), *Lygodium flexuosum* (Lygodiaceae), *Centrosema virginianum*(Fabaceae), *Tinospora cordifolia,*(Menispermaceae), *Wattakakka volubilis* (Asclepiadaceae) *Cyclea peltata* (Menispermaceae), *Calycopteris floribunda* (Combretaceae) *Pothos scandens*(Araceae) *Ipomoea separia* (Convolvulaceae) *and Piper nigrum* (Piperaceae). The stems of climbing plants are characterized by the scarcity of supporting cells (fibers) and an increase in the diameter of the xylem vessels. The study con firms that they show a greater diversity of organization than other plant life forms. This anatomical radiation could probably not exist without the achievement of a wide range of secondary growth processes. Many dicotyledons, notably those with a climbing habit, show interesting secondary structure which differs from the more usual type described, therefore, sometimes termed anomalous. The variant secondary growth is particularly widespread in tropical climbers. It is speculated that variant growth can increase stem flexibility, protect the phloem, increase storage parenchyma, aid in clinging to supports, limit physical disruption of vascular tissues during twisting and bending, and promote wound healing after girdling.

Keywords: Climbing plants, Anatomy.

1. INTRODUCTION

Climbing plants differ from self-supporting plants, such as shrubs and trees, in a range of characteristics. The most notable is the mechanical properties of the stem. Considering the tremendous number of possibilities for the functions and structures of stems, it is truly remarkable that there is only one single basic type in all of the vascular plants. In cross section, there is an outermost epidermis that overlies the cortex; the cortex in turn surrounds the vascular tissues. Climbing stems in primary growth with this basic type seems to be common. However, many variations of stem structure are usually called anomalies, can be seen in many climbers.

Climbing plants are found in numerous ecosystems, but are more abundant in low elevation tropical forests than in any other habitat. According to Gentry (1991), climbing plants in temperate forests represent on average 7% of the local flora, while in tropical forests this number reaches 20%. Lianas are characteristic of tropical forests, where at least 50% of the trees contain lianas.

Comparison of the differentiated anatomical structures recorded in 10 species of the climbing plants confirms that they show a greater diversity of organization than other plant life forms. This anatomical radiation could probably not exist without the achievement of a wide range of secondary growth processes. Many dicotyledons, notably those with a climbing habit, show interesting secondary structure which differs from the more usual type described, therefore, sometimes termed anomalous. The anomalous or unusual structure may be a consequence of

(1) a cambium of normal type which gives rise to unusual arrangements of secondary xylem and phloem, or

(2) a cambium which itself is abnormally situated and so gives rise to abnormal arrangements of tissues, or

(3) the formation of accessory or additional cambial zone

The variant secondary growth is particularly widespread in tropical climbers. It is speculated that variant growth can increase stem flexibility, protect

the phloem, increase storage parenchyma, aid in clinging to supports, limit physical disruption of vascular tissues during twisting and bending, and promote wound healing after girdling. Fisher and Ewers (1992) consider that the major benefits of variant xylem arrangements to climbers are not in their influence upon transport pathways, but rather in their mechanical and regeneration effects.

However, most of the information about cambial variants is based on the mature structure, and only a few developmental studies have been made (Nair 1993). Besides, as suggested by Caballé (1993), the study on the anatomical structure of liana stems should provide a highly efficient descriptive tool for the identification of taxa (families, genera or species)

The present study carried out a) To analyse the comparative stem structure of ten selected climbing species and b) To answer the inquiry whether these species present cambial variants or not and to verify the modes of cambial activities.

2. MATERIALS AND METHODS

In the present study the following ten climbing plants were selected from Aralam Wildlife Sanctuary.

1.*Centrosema virginianum (L) Benth* Family: Fabacee

2. *Piper nigrum L*. Family: Piperaceae

3. *Ipomoea separia Roxb*. Family: Convolvulaceae

4. *Pothos scandens L* Family: Araceaea

5. *Calycopteris floribunda (Roxb.) Poir*. Family: Combretaceae

6. *Cyclea peltata (Lam).Hook.f.andThoms*. Family: Menispermaceae

7. *Wattakaka volubilis Stapf* Family: Asclepiadaceae

9. *Lygodium flexuosum L*. (climbing fern) Family: Lygodiaceae

10. *Ampelocissus latifolia (Roxb.)Planch.* Family:Vitaceae

The stems of above mentioned plants were collected from nearby locality of Aralam wild life sanctuary, Kannur. The stems were sectioned by freehand. The cross-sections were stained using safranin (Souza *et al*. 2005) in agreement with usual techniques in plant anatomy (Gerrits 1991a,b). The illustrations were made by drawings (diagrams), obtained in light microscope equipped with camera lucida, and photomicrographs. Photomicrographs were obtained by processing the image captured in Olympus microscope with Cannon digital camera.

3. RESULTS

3.1. Centrosema virginian(L.) Benth.

The plants have hairs in the epidermis. But hairs are absent at the mature region of the stem. Cortex is sclerenchymatous. The stem have 13-17 vascular bundles, their distribution goes like follows, 13 vascular bundles at the 7th internodes, 17 vascular bundles at 3rd internodes, and 16 vascular bundles at the twisted portion. Large pith can be seen but a great controversy is seen within the pith and also in the stem. The stem of older region appears like two stems which are merged together and new branch is arises from the node as single stem and pith also shows variation in this plant. At older region the pith have a slit as it separates the two merged stems anatomically. But this slit is not seen at the younger stages. This splitting comes larger towards the base.

3.2. Piper nigrum L.

It is irregular in outline under microscopic observation. Ridges and grooves can be seen in the epidermis. Epidermis is followed by cortex which contains three layered collenchyma and four to five sclerenchyma then parenchyma, below it two to three layers of chlorechyama also seen. Vascular bundles are seen only in grooves, small and large vascular bundles are seen alternatly which is surrounded by wavy sclerechyama. The pith is delimited from the xylem by a wavy band of thick walled fibers. Pith is homogenous, it contain hexagonal parenchyma with medullary vascular bundles and schizogenous secretory canals are seen.

3.3. Ipomoea separia Roxb.

Hairs are seen in the epidermis. Heterogenous cortex. Succcessive rings of cambia can be seen. Interxylery phloem can be seen. Secondary xylem towards inner side is large. Large, homogenous, parenchymatous pith. The connective tissue is wide almost equal to vascular bundes. In mature stem vascular bundles are in different diameter.

3.4. Pothos scandens L.

Epidermis is seen more or less irregular with flat lateral sides and thick walled with lignified cells,circular in shape. Circular or parenchymatous ground tissue fills the cotex. Distinct layer of less thivk walled endodermis with two whorls of vascular bundles. Stellar vascular bundles scattered and densely occupied the stele and since pith cannot be differentiated.

3.5. Calycopteris floribunda (Roxb.)Poir.

Hairy epidermis. Cortex is differentiated into 5-6 layers of parenchyma, sclerenchyma and chlorenchyma . In vascular bundles outer and inner cambial segment seen at certain places. In secondary xylem sclereids are seen more than vessels. Homogenous large parenchymatous pith.

3.6. Cyclea peltata (Lam).Hook.f.andThoms.

Single layered hairy epidermis seen. Cortex is differentiated with three types of cells, two layers of collenchyma and chlorenchyma, wavy sheath of sclerenchyma present at the end. 8-10 vascular bundles seen. Secondary xylem is enormous. Pith is small in primarystructure but large in secondary structure.

3.7. Wattakaka volubilis Stapf

Wavy outline,hairs are present. Cortex have three layers of collenchyma, three layers of chlorenchyma and three layers of sclerenchyma. About 10-12 vascular bundles are seen, large and small vascular bundles are seen alternately. In secondary structure smallround bundles of phloem is seen in secondary cortex which is 12-15 layered chlorenchyma cells. In secondary xylem morevessels are seen in protoxylem region but in metaxylem region sclereids are seen.

3.8. Tinospora cordifolia Miers

Single layered epidermis . Below the epidermis collenchymatous cells seen which is starting of the cortical layer. Collenchyma cells are followed by three to four layered wavy sclerenchymatous cells, which foam a continuous ring. Parenchymatous cells are seen below this, the elongated cells become widened as we go towards pith. In mature stem pericyclic sclerenchyma and phloem persist in original. Arround 9 vascular bundles can be seen in primary structure. Vascular bundles differ in size alternatly. The fascicular and interfascicular cambium seen between the two vascular bundles. Vascular bundles. Vascular bundles increas in size and number as the stem grows older. Parenchymatous large pith with suberin deposition.

3.9. Lygodium flexuosum L.

Outermost epidermis, followed by sclerenchymatous cells. Parenchymatous cortex is present. And stele is protostel. The vascular bundle are arised from supernumerary cambial tissue. In secondary structure it has numerous vascular bundles. Large round pith, and pith is constricted in twisted rwgion.

3.10. Ampelocissus latifolia (Roxb.) Planch.

Hairy epidermis which is irregular in outline. Trichomes are also seen. Epidermis is followed by collenchyma. Sclerenchymatous cells, which is six layered is seen just below the grooves and this is followed by chlorenchymatous cells and rounded parenchyma. Bicollateral vascular bundles seen. Large vessels are seen at the innermost vascular bundles but small vessels are seen in the peripheral vascular bundles. Pith is almost absent in mature portion.

4. DISCUSSION

Climbing plants present numerous morphological and anatomical characteristics that distinguish them from other forms of plant life. Among these characteristics are the anatomical structure of the stems and the climbing and attachment mechanisms. Vines have long and flexible stems that depend on external support to maintain themselves erect or to reach illuminated areas in their habitat.

The stems of climbing plants are characterized by the scarcity of supporting cells (fibers) and an increase in the diameter of the xylem vessels, which may be visible to the naked eye. The increase in the diameter of the xylem vessels triplicates the conduction of water, making climbers able to maintain a great quantity of leaves in relation to the total diameter of their stems. (*Ampelocissus latifolia*) These stems that are specialized for the conduction of water are known only in plants that possess xylem vessels (elements with perforated walls), and are absent in those that have only tracheids or imperforate elements. Imperforate elements obviously represent an obstacle to the free flow of water, slowing it down and making water transport over great distances difficult.

The stems of climbing plants face structural challenges that differ from those experienced by trees and shrubs. They are subjected to tensile and compacting forces, due to the movement of the structures (usually small trees) that support them. For this reason their stem construction, with an alternation of vascular and parenchymatous tissues, gives them considerable flexibility to withstand these types of pressure (*Ampelocissus latifolia, Tinospora cordifolia and Cyclea peltata*). In addition, the stems of climbing plants are subject to friction against the host trees that can cut or tear irregularly their bark and thus wound the phloem tissue. Many lianas have encountered a solution to this problem by having phloem tissue inside the xylem. (*Tinospora cordifolia*

and *Calycopteris floribunda*). The arrangement of phloem tissue in relation to the xylem can produce patterns sometimes considered anomalous, which serve to characterize families or genera of climbers.

Alternation of bands of vascular tissue with connective tissue. This pattern is the result of the activity of successive bands of cambium that produce a band of vascular tissue (xylem and phloem) accompanied by a band of connective tissue (parenchyma). The cambial activity is repeated to produce successive concentric bands of vascular tissue and connective tissue. The connective tissue can be as wide as the vascular tissue, thus producing a conspicuous pattern of alternating bands. This pattern can be observed in *Ipomoea separia* of the family Convolvulaceae.

Non-concentric bands. This pattern, like the previous one, is the result of the activity of successive bands of cambium. In this case, however, the activity of the cambial tissue gives rise to asymmetric bands, which develop primarily toward only one sector of the stem, thus producing a stem whose pith is not in a central position. Examples of this pattern are seen in the Centranthera of the family Fabaceae, and in the *Cyclea peltata* of the family Menispermaceae.

Discrete vascular bundles. This pattern is the result of the activity of successive bands of cambium, which produce discrete bundles of xylem and phloem surrounded by parenchyma cells. The resulting pattern is that of collateral bundles dispersed in connective tissue (parenchyma). Examples of this type of pattern are found in *Tinospora cordifolia*

In one pattern, the peripheral vascular cylinders are of a smaller diameter than the central cylinder and can be seen both in young stems and in mature ones. Vascular Bundles are of different diameters. This pattern is visible only in mature stems. Examples are found in the genus *Ipomoea separia*

Compressed stem pattern, with the vascular cylinder in a central position, is obtained through asymmetrical secondary growth, in which the stem grows laterally in two opposing directions. Examples of this pattern are found in *Centrosema virginianum.*

In the climber, *Ampelocissus latifolia*, the aerial stem includes young stems with parenchymatous cortex and a cylinder vascular, as well as older stages with significant secondary growth of the vascular cambium and periderm.

Structure and development of included phloem was investigated in the stems of *Calycopteris floribunda*. After the definite period of cambial activity, cells in the middle of the cambial zone began to differentiate into thin walled cambial derivatives which separated the cambium into outer and inner cambial segment at certain places. Rest of the cambium along with separated outer segment remained functionally active while inner segment became temporarily nonfunctional. Original circular outline of the cambial cylinder was restored by joining of outer segment with existing one whereas inner cambial segment got embedded resulting in production of an islands of included phloem in the secondary xylem. This process was repeated several times resulting in a number of phloem islands surrounded within thick walled secondary xylem. Differentiation of phloem elements was initiated only after the formation of thick walled xylem derivatives from the outer cambial segment. The segments of the cambium producing the phloem island remained active for fairly long time. Sieve tube elements of the phloem islands situated deep inside the older stem became non-functional and underwent obliteration after heavy accumulation of callose. Secondary xylem was diffuse porous with indistinct growth rings and composed of vessels (both wider and fibriform vessels), nucleated xylem fibers, axial and ray parenchyma.

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CONSERVATION OF BIODIVERSITY AND SOCIO-CULTURAL DIMENSIONS OF SACRED GROVES OF KANNUR DISTRICT, KERALA

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ABSTRACT

Sacred groves are small patches of forests, protected by local communities on religious grounds, rituals and culture. It represent a tradition of nature worship by dedicating patches of forests to deities and providing protection to such forest patches. They have immense value from genetic and ecological point of view. Results of studies conducted in eleven sacred groves in Kannur district of Kerala are compiled in this paper. Two hundred and three plant species including 10 true mangroves give an insight into the bio-ecological and socio cultural dimensions of sacred groves in helping and conserving the biological diversity. Kaliyattam a performing art with different forms of 'theyyam' is conducted every year offering to propitiate the deity by different communities in the villages. 'Devakooth' a theyyam performed by women in Thekkumpad kavu. is noteworthy among the performative rituals. These ritualistic practices centred around the sacred groves substantially contribute to the conservation and day- to-day management of ecological balance by sacred groves. The different types of roles played by sacred groves in maintaining the ecosystem integrity and biodiversity conservation are also presented in this paper.

Keywords: Biodiversity, Sacred groves, Kannur, Kerala.

1. INTRODUCTION

The socio-ecological system integrating with its cultural and spiritual dimensions with is still strong amongst many traditional societies. The initial impetus amongst traditional societies for conservation of biodiversity seems to have arisen out of the animistic religious belief system. The concept of "sacred grove" could be viewed as symbolic of "nature-human" inter connections with a variety of ritual linked to the diverse community living within the landscape boundary, who have their own right for natural resourse use, large communuty participation is ensured (Ramakrishnan, 2005). Sacred groves are patches of climax vegetations of past, reserved on religious grounds. They have immense value from genetical and ecological point of view. These are natural treasure houses of plants and animals that can satisfy the scientific, cultural, aesthetic needs of mankind.Traditional ecological knowledge and its functioning in India is a compled subject and least understood. Kerala is said to have about 360 groves which contain 660 plant species(Induchoodan, 1992).However it is estimated that in two Northern districts of Kerala,(Kannur, Kasargod) there are more than 1000 groves (Unnikrishnan,1995). The kavu helps to conserve the diversity of plants and animals and also to build up and maintain cultural diversity of the region by providing platform for perfoming arts like "theyyam" and other festivals(Kunhikannan, 2005)

The presents study was carried out with to study the floristic diversity of certain sacred groves in Kannur and to elucidate the role of sacred groves in biodiversity conservation with sustainable livelyhood of traditional and cultural aspects.

2. MATERIALS AND METHODS

The presents study was carried out with to study the floristic diversity of eleven sacred groves in Kannur and to elucidate the role of sacred groves in biodiversity conservation with sustainable livelyhood of traditional and cultural aspects. The following sacred groves are selected for the study.

1) Madaikavu at Madai
2) Kunnathu Kavu, Pannenpara
3) Kizhakken Kavu, Chekkikulam
4) Muchilottu Kavu, Narathu
5) Neeliyar Kottam Kavu, Parassinikadavu

6) Sri Thundikoth Bhagavathi Kshetram, Valiyannur
7) Valiavalappu Kavu, Thavakkara
8) Thalikkavu Sri Bhagavathi Kshethram, Thalikkavu
9) Kalarivathukal Bhagavathi Temple, Valapattanam
10) Aanthur Kavu, Parassinikadavu
11) Thekkumpad and Thaze kavu

Madaikavu is a famous sacred grove situated at Iripuram in Pazhayangadi about 20km north of Kannur town. It is densely biodiverse region spreading about 1 0.5 acres. It is situated on the famous Madayi hills. Regarding the myths, the deity here is Madaikavilamma. Records suggest that this kavu was present even before 1300 AD. This is many centuries old and ancient records say that the Sri Rajarajeswara temple at Thaliparamba and Madayikavu are very closely related. The Kunnathu Kavu situated in Pannenpara the deity is Bhavur Karinkali, Kizhakkan Kavu is situated in Chekkikulam, Muchilottu Kavu is situated in Narathu, Neeliyar Kottam kavu is situated in Managattuparamba, Thundikoth Bhagavathi Kshetram is situated in Valiyanoor. The deity here is Bhagavathi, Valiyavalappu Kavu is situated in the middle of the town at Thavakkara. It is said to be more than 300 years old.

Fig. 1 Selected Sacred Groves in Kannur

Madai Kavu **Aanthur Kavu**

Neeliarkottam Kavu **Madai vegetation**

Thali kavu

Thekkumpad kavu and Wetland s around the Sacred grove

Fig. 2. Believes and Conservation
(Rituals /Spirutuals)

Theechamunndi **Gulikan**

Devakkooth **Karanavar**

Devakkooth at Thekkumbad **Maritheyyam at Madayi kavu**

Thalikavu Sri Bhagavathi Kshetram. It is one of the oldest and still diverse sacred grove. It is situated at Thalikkavu in Kannur town itself. It is

dated back to 250 years. Kalarivathukkal Bhagavathi Temple, Valapattanam,the 'Theyyam and Thira' festival of entire North Malabar is binded to this temple. It is a large sacred grove. Outside the sanctum sanatorium to the east is the Saraswathy Kshetram, to the north is the Nagakkavu and at the east is the great old banyan tree which is worshipped even today believing that the goddess had swing there. Aanthur Kavu situated nearby Parassinikadavu, the deity of this kavu is Bhagavathi.

Thekkumbadu village is a part of large cultural landscape within interconnections between the various ecosystem types, such as wetland ecosystems, water bodies, human management (kaippad paddy field) patch of forest around the sacred grove and mangrove forest ecosystem placed within a resource rich landscape unit provided the appropriate climate for sustaining protected forest ecosystem in the form of sacred groves(Thaye kavu), agro ecosystem(kaippad paddy cultivation between two kavu) and mangrove forest ecosystem.

The inhabitants around this wetland sacred grove of thekkumbadu maintain a spiritual connection and are integral part of there lives. The coastal marine ecosystems/wetland ecosystems are known to be productive, exceedingly valuable areas among the various biodiversity regions of the World. Living along the interface between land and sea, the mangrove ecosystem support genetically diverse groups of aquatic and terrestrial organisms.

3. RESULTS AND DISCUSSION

Kannur known as the land of looms and lores is famous for its rituals and custom based on ancestry which had played a lot in preserving the biodiversity at least to a small extent. Sacred groves are important among them. It helped a lot in Biodiversity conserved of the district directly and indirectly.

Table 1. List of plant species identified in Madaikavu, Madai.

S.No	Botanical Name	Family	Common Name
1	*Erythrina variegata* .L	Malvaceae	Murikku
2	*Glycerdia cepia*	Fabaceae	Sheemakonna
3	*Ficus religiosa* L.	Moraceae	Arrayal
4	*Aeglaia roxburchi* Hiern	Meliaceae	Punyava
5	*Vernonia cinerea* Less	Asteraceae	Poovamkurunthal
6	*Justicia japonica* Thumb	Acanthaceae	Neelipoochedy
7	*Utricularia aurea* Lour	Lentibulariaceae	Kakkapoovu
8	*Coleus umbonicus* L.	Lamiaceae	Mathilkoorkka
9	*Justicia procumbens* L.	Acanthaceae	
10	*Pouzolzia indica* Gaud	Urticaceae	Neycheera
11	*Dalbergia volubilis* Roxb.	Fabaceae	Jadavally
12	*Sopubia trifida* Ham	Scrophulariaceae	Kunhikolambi
13	*Justicia ekakusuma*	Acanthaceae	Eakakusumam
14	*Heliotropium indicum* L.	Boraginaceae	
15	*Neonotonia wightii* Lackey	Fabaceae	Paraneelapoovu
16	*Rotala malambuzhansis*	Lithraceae	Thadripoovu
17	*Vallisneria spiralis* Linn.	Hydrocharitaceae	Ribbon plant
18	*Nymphoides krishnakesara*	Nympheaceae	Pootthally
19	*Euphorbia kathragenesis*	Euphorbiaceae	Paalutti
20	*Impatiens balsamina* L.	Balsaminaceae	Kashithumba
21	*Zizyphus mauritiana* (Lamk.)	Rhamnaceae	Vanthutali
22	Rauvolfia serpentina	Apocyanaceae	Sarppagandhi
23	*Curcuma cannanorensis* Ansari *et al*	Zingeberaceae	Kattumanghal
24	*Utricularia polygaloides* Linn.	Urticaceae	Kakkpaoovu
25	*Lidernia ciliata* (Colsm)	Scrophulariaceae	Chiravanakku
26	Rotala malabaricum	Lythraceae	Parathamara
27	*Sapium insign* Benth	Eurphorbiaceae	Kanmaram
28	*Strychnos rux.vomica* L.	Loganiaceae	Kanhiram
29	*Curculego orchioides* Gaertn	Hypoxidaceae	Nilappana
30	*Plumeria accuminata* Ait.	Apocynaceae	Pala
31	*Sida rhombifolia* L.	Malvaceae	Kurumthotty

32	*Leucas plukenetii* (Roth) Spreng.	Lamiaceae	Thumba
33	*Xanthium indicum* Roxb	Asteraceae	Karamullu
34	*Phyllanthus amarus* schum Th	Euphorbiaceae	Keezharnelly
35	*Lantana camara* L	Lamiaceae	Kattuthulasi
36	*Physalis minima* Linn.	Solanaceae	Muttambigha
37	*Cyclea peltata* Diels	Pedaliaceae	Ellumpoovu
38	*Zehneria scabra* Sond.	Cucurbitaceae	Kurukkanvellary
39	*Ipomaea sepiaria* Koen	Convolvulaceae	Palamthangi
40	*Micrococca mercurialis* Benth.	Eurphorbiaceae	Kunukady
41	*Anamirta cocculus* W and A	Cucurbitaceae	Padolam
42	*Merremia tridentata L. Hall.f.*	Convolvulaceae	Thiruthali
43	Flacourtia montana Grah	Pittosporaceae	Karuvachakka
44	*Celosia argentea Linn.*	Amaranthaceae	Mayoorasika
45	*Desmodium triflorum (L.) DC*	Papilionaceae	Nilamparanda
46	*Smithia conferta J.E. Smith*	Leguminosae	
47	*Memecylon malabaricum cogn*	Melastomaceae	Kayamboo
48	*Amorphophallus dubius Bl.*	Araceae	Chena
49	*Biophytum sensitivum DC*	Gerahiaceae	Mukkutty
50	*Ericaulon*	Ericaulaceae	Choothu
51	*Colocassia esculentum*	Araceae	Thalu
52	*Oroxylum indicum (L.) Vent.*	Bignoniaceae	Mothiravalli
53	*Plumbago zeylanica L.*	Plumbaginaceae	Vellakoduveli
54	*Cryptolepis buchananii Roem.andSchult*	Asclepidaceae	Palvalli
55	*Elephantopis scaber L.*	Asteraceae	Aanachuvadi
56	*Justicia japonica Thunb.*	Acanthaceae	Karimaram
57	*Evolvulus nummularis*	Convolvulaceae	Vishnukranthi
58	*Buchanania augustifolia Roxb.*	Anacardiaceae	
59	*Premna latifolia (Roxb.)*	Verbenaceae	Munja
60	*Vitex trifolia L.*	Verbenaceae	Notchi
61	*Murdannia nudiflora (L.) Brenan*	Commelinaceae	Paravellamkudiyan
62	*Ageratum conizoides (L.)*	Asteraceae	Appakkadu
63	*Jatropha glandulifera Roxb.*	Euphorbiaceae	Nattavanakku

Table 2. **List of plant species identified in Kunnathu Kavu, Pannenpara.**

S.No	Botanical Name	Family	Common Name
1	*Dioscoria alata*. L	Dioscoreaceae	Kachhil
2	*Clerodendrum viscosum* vent	Verbenaceae	Vattaperuvalam
3	*Mallotus philippinensis* M.Arg	Euphorbiaccae	Kurukutty
4	*Piper nigrum* L	Piperaceae	Thippali
5	*Naregamia alata* wight and Arn.	Meliaceae	Nilanarakam
6	*Citrus grandis* Osbeck	Rutaceae	Bambloose
7	*Cyclea peltata* (Lamk) Hoof. F and Thoms	Menispermaceae	Padavally
8	*Wattakaka volubilis* (L.f) stapf	Asclepiadiaceae	Palvally
9	*Lindernia ciliata* Pennell	Scrophulariaceae	Chiravanakku
10	*Calycopteris floribunda* (Roxb) Poir	Combretaceae	Pullanhi
11	*Caryota urens* L	Arecaceae	Anappana
12	*Holigarna arnottiana* Hook.f	Anacardiaceae	Cheru maram
13	*Plumeria rubra* L.	Apocynaceae	Chembakam
14	*Cassia fistula* L	Caesalpiniaceae	Konna
15	*Acacia auriculiformis* L	Mimosae	Acacia
16	*Hibiscus rosasinensis* L	Malvaceae	Chembarathy
17	*Santalum album* L	Santalaceae	Chandanam
18	*Artocarpus heterophylla* Lam.	Moraceae	Plavu
19	*Anacardium occidentale* L	Anacardiaceae	Kashumavu

20	*Emilia sonchifolia L*. DC	Asteraceae	Muyalcheviyan
21	*Phyllanthus amarus* schum and Thonn	Euphorbiaceae	Kizharnelly
22	*Tectona grandis* L.f	Verbenaceae	Jathi
23	*Curculigo orchioides* Gaertn	Hypoxidaceae	Nilappana
24	*Ocimum sanctum* L	Lamiaceae	Thulasi
25	*Alstonia scholaris* L. R. Br.	Apocynaceae	Ezhilampala
26	*Costus speciosus* (Koenig) smith	Zingiberaceae	Kanhipoovu
27	*Adenanthera pavonina* L	Mimosae	Manjadi
28	*Pathos scandens* L	Araceae	Paruvakodi
29	*Vigna vexillata* L. A. Rich	Papilionaceae	Kattuzhunnu
30	*Mimusops elengi* L	Sapotaceae	Elanghi
31	*Piper betle* L	Piperaceae	Vettila
32	*Biophytum sensitivum* DC	Oxalidaceae	Mukkutty
33	*Zehneria scabra* Sond	Cucurbitaceae	Kurukkanvellary

Table 3. List of plant species identified in Kizhakken Kavu Chekkikulam.

S.No	Botanical Name	Family	Common Name
1	*Mussaenda frondosa* L.	Rubiaceae	Vellila
2	*Hibiscus rosasinensis* L.	Malvaceae	Chembarathy
3	*Ocimum sanctum* Linn.	Lamiaceae	Thulasi
4	*Glycerdia cepia*	Fabaceae	Sheemakonna
5	*Plumaria accuminata* Ait.	Apocynaceae	Chembakam
6	*Ipomoea pentaphylla* Jacq.	Convolvulaceae	Anchilachedi
7	*Lantana camara* L	Verbenaceae	Aripoo
8	*Xanthium streumarium* Wight	Asteraceae	Karamullu

Table 4. List of plant species identified in Muchilottu Kavu, Narathu.

S.No	Botanical Name	Family	Common Name
1	*Rauvolfia serpentina* Benth	Apocynaceae	Sarppagandhi
2	*Zehneria scabra S*ond.	Cucurbitaceae	Kurukkan vellary
3	*Carallia barachiata* (Lour.) Merr.	Rhizophoraceae	Vanghanna
4	*Chasalia curviflora* Thw.	Rubiaceae	Velutha aval pori
5	*Santalum album* L	Santalaceae	Chandanam
6	*Stachytarpheta urticaefolia* (salisb.) sims.	Verbenaceae	Chiravanakku
7	*Justicia prostrata* (cl.) Gamble	Acanthaceae	
8	*Lygodium fluxos* smith	Pteridophyta	Polivally
9	*Quisqualis indica* L	Combretaceae	Kulamarinhi

Table 5. List of plant species identified in Neeliyar Kottam Kavu, Parassinikadavu.

S.No	Botanical Name	Family	Common Name
1	*Alangium salvifolium* Wang.var	Alangiaceae	Angholam
2	*Desmos lawii* (Hook.f. and Thoms)	Anonaceae	Panal
3	*Artabotrys zeylanicus* Hk.f.	Anonaceae	
4	*Knoxia wightiana* wall	Rubiaceae	
5	*Jasminum ritchii* Cl.	Oleiaceae	Kattupichhakam
6	*Memecylon lawsoni* Gamb	Melastomaceae	
7	*Sonerila rheedii* W.and A.	Melastomaceae	
8	*Strychnos nux- vomica* L.	Loganiaceae	Kanhiram
9	*Bulbophyllum neilgherrense* wight	Orchidaceae	Punnilachedi

Table 6. List of plant species identified in Sri Thundikoth Bhagavathi Kshetram,Valiyannur.

S.No	Botanical Name	Family	Common Name
1	*Ocimum sanctum* Linn	Lamiaceae	Thulasi
2	*Plumaria accuminata* Ait	Apocynaceae	Chembakam
3	*Terminalia catappa* Linn	Combretaceae	Badam
4	*Cassia fistula* L	Caesalpiniaceae	Konna
5	*Mangifera indica* L.	Anacardiaceae	Mavu
6	*Anacardium occidentale* L	Anacardiaceae	Kashumavu
7	*Cleome viscose* L.	Capparidaceae	Kattukaduku
8	*Leucas plukenetti* (Roth)Spreng.	Lamiaceae	Thumba
9	*Tridax procumbens* L.	Asteraceae	Thalatherippan
10	*Vernonia cinerea* Less	Asteraceae	Poovamkurunthal
11	*Aerva lanata* L. schult	Amaranthaceae	Cheroola
12	*Cyathula prostrata* (L.) Bl	Amaranthaceae	Aanachuvadi
13	*Mitracarpus verticillatus*(schum and Thonn)	Rubiaceae	-
14	*Mimosa pudica* L	Mimosae	Thottavady
15	*Sida rhombifolia* L.	Malvaceae	Kurumthotty
16	*Phyllanthus amarus* Schum and Thonn	Euphorbiaceae	Keezharnelly
17	*Scoparia dulcis* L.	Scrophulariaceae	Kallurukky
18	*Gloriosa superba* L.	Liliaceae	Mendhonni
19	*Cassia mimosoidis* L.	Caesalpiniaceae	-
20	*Crotolaria striata* DC.	Fabaceae	Kilukkampatti
21	*Hedyotis diffusa* willd	Rubiaceae	
22	*Portulaca oleracea* L.	Portulacaceae	pathumanipoov
23	*Ludwigia hyssopifolia* (G.Don)Exell	Onagraceae	-
24	*Memecylon umbellatum* Burm.F.	Melastomaceae	Kayambu

Table 7. List of plant species identified in Valiavalappu Kavu, Thavakkara.

S.No	Botanical Name	Family	Common Name
1	*Amaranthus irridis* L.	Amaranthaceae	Mullancheerra
2	*Sesamum indicum* L.	Pedaliaceae	Kattellu
3	*Carica papaya* Linn.	Caricaceae	Papaya
4	*Mukia maderaspatana* L. Roem.	Cucurbitaceae	Kattuvellary
5	*Ageratrum conyzoides* L.	Asteraceae	Appa
6	*Colocasia esculenta* L.	Araceae	Kattu chembu
7	*Plumaria accuminata* Ait.	Apocynaceae	Chembakam
8	*Tamarindus indicus* L.	Caesalpiniaceae	Puli
9	*Strychnos nux-vomica* L.	Loganiaceae	Kanhiram
10	*Leucas blukenetii* (Rosh.) Spreng.	Lamiaceae	Thumba
11	*Tagetus erectus*	Asteraceae	Chetty
12	*Hyptis suaveolens* (L.) Poir	Lamiaceae	Kattuthulasi
13	*Calotropis gigantea* R.Br.	Asclepiadaceae	Erikku
14	*Sida rhombifolia* L.	Malvaceae	Kurumthotty
15	*Anona squamosa* L.	Anonaceae	Aathachakka
16	*Curculigo orchioides* Gaertn	Hypoxidaceae	Nilappana
17	*Adhatoda vasica* Nees.	Acanthaceae	Adalodakam
18	*Desmodium trifolium* L. DC.	Leguminosae	Nilamparanda
19	*Macaranga peltata* (Roxb.) Huell Arg.	Euphorbiaceae	Uppila
20	*Crotalaria striata* DC.	Papilionaceae	Kilukilukkipoo
21	*Lantana camara* L.	Verbenaceae	Arippoo
22	*Ficus carica*	Moraceae	Atthi
23	*Datura metel* L.	Solanaceae	Ummam
24	*Ocimum sanctum* Linn.	Lamiaceae	Krishnathulasi
25	*Cassia tora* L.	Caesalpiniaceae	Thavara

Table 8. List of plant species identified in Thalikavu Sri Bhagavathi Kshetram Thalikavu.

S.No.	Botanical Name	Family	Common Name
1	*Plumeria acuminata* Ait.	Apocynaceae	Chembakam
2	*Strychnos nux-vomica* L.	Loganiaceae	Kanhiram
3	*Ficus religiosa* L.	Moraceae	Arayal
4	*Aegle marmelose* corr	Rutaceae	Koovalam
5	*Cassia fistula* L.	Caesalpiniaceae	Konna
6	*Sida rhombifolia* L	Malvaceae	Kurumthotty
7	*Crotalaria pallida* Dryand	Papilionaceae	Kilukilukkipoovu
8	*Gloriosa superba* L.	Liliaceae	Mendhonni
9	*Hyptis suaveolens* L. Poir	Lamiaceae	Kattuthulasi
10	*Leucas plukenetii* (Roth) spreng	Lamiaceae	Thumba
11	*Mimosa pudica* L.	Mimosae	Thottavadi
12	*Datura metel* L.	Solanaceae	Ummam
13	*Cleome viscosa* Linn	Capparidaceae	Kattukadugu
14	*Macaranga peltata* (Roxb.) Muell-Arg.	Euphorbiaceae	Uppila
15	*Rauvolfia serpentina* (L) Kurz	Apocynaceae	Sarppaghandhi
16	*Curculigo orchioides* Gaertn.	Hypoxidaceae	Nilappana
17	*Mussaenda frondosa* L.	Rubiaceae	Veleela
18	*Caryota urens* L.	Arecaceae	Aanapanna
19	*Zizyphus oenoplia* L. Mill	Rhamnaceae	Kottakapazham
20	*Spondias pinnata* L.f. kurz.	Anacardiaceae	Ambayam
21	*Tabernaemontana heyneana.* Wall	Apocynaceae	Pala
22	*Pouzolzia wightii* Benn-Pl. Jan Rar	Urticaceae	Neycheera
23	*Cassia tora* L.	Caesalpiniaceae	Thavara
24	*Colocassia esculenta* L.Schotta	Araceae	Thalu
25	*Ocimum sanctum* Linn.	Lamiaceae	Krishnathulasi
26	*Ageratum conyzoides* L.	Asteraceae	Appa
27	*Urena lobala* L.	Malvaceae	Uthiram
28	*Uvaria narum* (Dunal) Wall.	Anonaceae	Nagavalli
29	*Jasminum multiflorum* Burm.f	Oleaceae	Kattumulla
30	Tagetus erectus	Asteraceae	Chetty

Table 9. List of plant species identified in Kalarivathukal Bhagavathi Kshetram, Valapattanam.

S.No.	Botanical Name	Family	Common Name
1	*Pothos scandens L.*	Araceae	Paruvakodi
2	*Mallotus philippensis (Lam.) Muelt Arg.*	Euphorbiaceae	Koovukoodi
3	*Calycopteris floribunda (Roxb.) Poin*	Combretaceae	Jadapoovu
4	*Strychnos nux-vomica L.*	Loganiaceae	Kanhiram
5	*Alstonia scholaris L.R.Br.*	Apocynaceae	Ezhilampala
6	*Phyllanthus emblica Schum Th*	Euphorbiaceae	Nelli
7	*Caryota urens L.*	Arecaceae	Anappana
8	*Cassia occidentalis L.*	Caesalpiniaceae	May flower
9	*Santalum album L.*	Santalaceae	Chandanam
10	*Dalbergia volubilis Roxb.*	Fabaceae	Jadavally
11	*Plumeria acuminata Ait.*	Apocynaceae	Chembakam
12	*Quisqualis indica L.*	Combretaceae	Kulamarinhi

Table 10. List of plant species identified Aanthur Kavu, Parassinikadavu.

S.No	Botanical Name	Family	Common Name
1	*Calyopteris floribunda* (Roxb.) Poir.	Combretaceae	Jadapoovu
2	*Strychnos nux-vomica* L.	Loganiaceae	Kanhiram
3	*Mussaenda frondosa* L.	Rubiaceae	Veleela
4	*Plumeria accuminata*. Ait.	Apocynaceae	Chembakam

5	*Aegle marmelos* corr.	Rutaceae	Koovalam
6	*Ficus religoisa* L.	Moraceae	Arayal
7	*Curculigo orchioides* Gaertn.	Hypoxidaceae	Nilappana
8	*Caryota urens* L.	Arecaceae	Aanappana
9	*Azadirachta indica* A Juss	Miliaceae	Veppu
10	*Santalum album* L.	Santalaceae	Chandam
11	*Tectona grandis* L.f.	Verbenaceae	Jadhi
12	*Holigarna arnottiana* Hook.f.	Anacardiaceae	Cheru maram
13	*Alstonia scholaris* (L.) R. Br.	Apocynaceae	Ezhilampala
14	*Ocimum sanctum* Linn.	Lamiaceae	Thulasi
15	*Emilia sonchifolia* (L.) DC	Asteraceae	Muyal cheviyan
16	*Cassia fistula* L.	Caesalpiniaceae	Konna
17	*Anona squamosa* Linn.	Anonaceae	Aathachakka
18	*Sida rhombifolia* L.	Malvaceae	Kurumthotty
19	*Jasminum muttiflorum* Burm.f.	Oleaceae	Kattumulla
20	*Memecylon umbellatum* Burm.f.	Melastomaceae	Kashavu
21	*Mimusops elengi* Linn	Sapotaceae	Elanghi

Table 11. Plants collected from Thekkumbad (Mangrove Associated Plants).

S.no	Botanical name	Family	Local name	Habit
1	*Utricularia reticulate **J**. E .Sm*	Lentibulariaceae	Kakkapoovu	Herb
2	*Cyanotis cristata (L.) D .Don*	Commelinaceae		Herb
3	*Ipomoea pes-caprae (L.) Sweet*	Convolvulaceae		Herb
4	*Cyperus rotundus L . Sp. Pl*	Cyperaceae	Muthanga	Herb
5	*Carex filicina Nees*	Cyperaceae		Herb
6	*Clerodendrum inerme (L.)*	Verbenaceae		Shrub
7	*Eicchornia crassipes (Mart.) Solms*	Pontederiaceae		Herb
8	*Sphaeranthus indicus L.*	Asteraceae		Herb
9	*Exacum tetragonum Roxb . Fl*	Gentianaceae		Herb
10	*Ludwigia octovalvis (Jacq.)Raven*	Onagraceae		Herb
11	*Wedelia biflora (L.) DC*	Asteraceae	Kammal poovu	Herb
12	*Premna serritifolia L.*	Verbenaceae		Shrub
13	*Cassia mimosoides L.*	Caesalpiniaceae		Herb
14	*Scirpus dichotoma L.*	Cyperaceae		Herb
15	*Eclipta alba prostrata (L.)L.Mant*	Asteraceae	Kayyoonji	Herb
16	*Ageratum conyzoides L.*	Asteraceae		Herb
17	*Lindernia crustacean (L.)F.v-Muell*	Scrophulariaceae		Herb
18	*Limnophila indica (L.)Druce*	Scrophulariaceae		Herb
19	*Commelina benghalensis L.*	Commelinaceae	Vazhapadathi	Herb
20	*Desmodium triflorum (L.)*	Papilionaceae		Herb
21	*Desmodium laxiflorum Dc*	Papilionaceae		Herb
22	*Oldenlandia repens L.*	Rubiaceae		Herb
23	*Derris trifoliata Lour.Fl.*	Papilionaceae		Climbing shrub
24	*Eriocaulon dianae Fyson var.*	Eriocaulaceae		Herb
25	*Crotalaria juncea L.*	Papilionaceae		Herb
26	*Scoparia dulcis L.*	Scrophulariaceae	Kallurukki	Herb
27	*Synedrella nodiflora L.*	Asteraceae		Herb
28	*Vernonia arboriea Buch –Ham*	Asteraceae	Poovakurundal	Herb
29	*Sida acuta Burm.f.Fl*	Malvaceae	Kurundhotti	Herb
30	*Leucas aspera (Wild.)Link*	Lamiaceae	Thumba	Herb
31	*Gloriosa superb L.*	Liliaceae	Mendonni	Climber
32	*Vanda roxburghii R.Br*	Orchidaceae	Maravazha	Herb
33	*Ixora coccinea L.*	Rubiaceae	Kattu thechi	Shrub

34	*Lantana camara L.*	Verbenaceae	Arippu	Shrub
35	*Justicia simplex D.Don*	Acanthaceae		Herb
36	*Mimusops elengi L.*	Sapotaceae	Elangi	Tree
37	*Ficus religiosa L.*	Moraceae	Arayal	Tree
38	*Costus speciosus (koen.) Smith*	Zingiberaceae		Herb
39	*Mukia maderaspatana (L.)*	Cucurbitaceae	Kurukan vellari	Climber
40	*Erythrina variegate Lam.*	Papilionaceae	Murikke	Tree
41	*Bacopa monnieri (L.)*	Scrophulariaceae	Brammi	Herb
42	*Tinospora cordifolia (Thunb.) Miers*	Menispermaceae	Chittamrudh	Climber
43	*Arenga wightii Griff*	Arecaceae	Kaattupana	Tree
44	*Bombax ceiba L.*	Bombacaceae	Theepetimaram	Tree
45	*Holigarna arnottiana Hook.*	Anacardiaceae	Cheru maram	Tree
46	*Thespesia populnea (L.)*	Malvaceae	Puvarasu	Small tree
47	*Melastoma malabathricum L.*	Melastomataceae	Athiraani	Shrub
48	*Cinnamomum zeylanicum Garc.*	Lauraceae	Karuvapatta	Tree
49	*Calophyllum inophyllum L.*	Clusiaceae	Attupunnam	Tree
50	*Morinda citrifolia L.*	Rubiaceae	Manjanathi	Tree
51	*Cerbera manghas*	Apocynaceae	Othalom	Small tree
52	*Aerva lanata (L.)*	Amaranthaceae	Cherupula	Herb
53	*Pandanus fascicularis L.*	Pandanaceae	Kaitha	Small tree
54	*Ipomoea companulata L.*	Convolvulaceae	Manippoovu	Climber
55	*Glyricidea sepia (Jacq.)Walp.*	Papilionaceae	Seemakonna	Tree
56	*Ananas comosus Mill.*	Bromeliaceae	Kaitha chakka	Shrub
57.	*Calamus rotang L.*	Arecaceae	Chooral	Shrub
58	*Vitis trifolia L.*	Vitaceae	Kaatumunthiri	Climber
59.	*Ocimum sanctum L.*	Lamiaceae	Thulasi	Herb
60.	*Hyptis suaveolens L.*	Lamiaceae	Katuthulasi	Herb
61.	*Heliotropium indicum L.*	Boraginaceae		Herb
62.	*Rauvolfia serpentina*	Apocynaceae	Sarpagandhi	Herb
63.	*Alstonia constricta*	Apocynaceae	Pala	Tree
64	*Dioscoria alata*	Dioscoriaceae	Kaachil	Climber
65.	*Eupatorium odaratum*	Asteraceae	Communistpacha	Shrub
66.	*Colacasia esculenta*	Araceae	Chembu	Herb
67.	*Euphorbia hirta*	Euphorbiaceae		Herb
68.	*Biophytum sensitvum*	Oxalidaceae	Mukutti	Herb
69.	*Tectona grandis L.f.*	Verbenaceae	Teak	Tree
70.	*Melochia corchorifolia L.*	Sterculiaceae	Mullan chedi	Herb
71.	Coix lacremajobi	Poaceae	Kalla chedi	Herb
72.	Alysicarpus vaginalis	Papilionaceae		Herb

Table 12. True Mangrove plants collected from Thekkumpad.

S.no	Botanical name	Family	Local name	Habit
1	*Acanthus ilicifolius L.*	Acanthaceae	Chulli	Shrub
2	*Aegiceras corniculata L.*	Myrsinaceae	Chakkara kandal	Tree
3	*Avicennia marina Fosk)vierh*	Avicenniaceae	Uppatti	Tree
4	*Avicennia officinalis L.*	Avicenniaceae	Oori	Tree
5	*Bruguiera cylindrical (L)Bl*	Rhizophoraceae		Tree
6	*Exoecaria agallocha L.*	Euphorbiaceae	Kannampotti	Tree
7	*Kandelia candel (L)Druce*	Rhizophoraceae	Poo kandal	Tree
8	*Rhizophora mucronata.Lamk*	Rhizophoraceae	Pranthan kandal	Tree
9	*Rhizophora apiculata Blume*	Rhizophoraceae		Tree
10	*Sonneratia alba J.Smith*	Sonneratiaceae	Nakshatra kandal	Tree

Table 13. Cultivated crops.

S.no	Botanical name	Family	Local name	Habit
1	*Oryza sativa L.*	Poaceae	Nellu	Herb
2	*Musa paradisiacal L.*	Musaceae	Vaazha	Gigantic herb
3	*Cocos nusifera L.*	Arecaceae	Thengu	Tree
4	*Ipomoea batatas .L*	Convolvulaceae	Madura kizhangu	Trailing herb
5	*Zingiber officinalis Rose.*	Zingiberaceae	Injhi	Herb
6	*Maranta arundinaaceae L.*	Marantaceae	Koova	Herb
7	*Manihot esculenta*	Euphorbiaceae	Maracheeni	Shrub
8	*Cucumis sativus L.*	Cucurbitaceae	Vellari	Climber
9	*Lathyrus sps.*	Papilionaceae	Kota payar	Climber
10	*Trichosanthes anguina L.*	Cucurbitaceae	Padavalam	Climber

In the present study eleven important sacred groves are selected in Kannur district. The floristic diversity of selected ten sacred groves shows 151 of plant species and 131 genera belong to 56 families were reported in ten sacred groves. Among the these in Madayi kavu reported 63 plant species, followed by Kunnathu kavu 33 species, Thalikavu 30 species, Valiavalappu kavu 25 species, Thundikoth Bhagavathi Kshetram 24 species,Aanthur kavu 21 species, Kalarivathukal Bhagavathi Temple 12 species, Muchilottu kavu and Neeliarkottam kave recorded 9 species each and , Kizhakken kavu recorded only 8 species. The kavu helps to conserve diversity of plants and animals and also to build up and maintain cultural diversity of the region by providing platform for performing arts like"theyyam" and other festivals (Kunhikannan, 2005). The list plants collected from these scred groves are presented in Table1-10.

The Thekkumpad kavu has the unique nature compared to the above ten sacred grove In the present study, 92 plant species identified, of these 92 species, 72 species are mangrove associates and 10 species are true mangroves. The list plants collected from these scred groves are presented in Table11-14. The recorded true mangroves are *Acanthus ilicifolius*. L, *Aegiceras corniculata* L, *Avicennia marina* (Forsk)Vierh, *Avicennia officinalis* L, *Avicennia alba* Blume, *Bruguiera cylindrical* (L) Bl, *Bruguiera gymnorhiza* L, *Exoecaria agallocha* L, *Kandelia candel* (L) Druce, *Rhizophora mucronata* Lamk, *Rhizophora apiculata* and *Sonneratia alb*a J.Smith.Ten species are identified as cultivated plants by the local peoples. These 92 plant species belongs to the 48 family and 87 genera. The herbaceous plants are dominant in Thekkumpad and 47 herbaceous plants are identified. Trees, shrubs and climbers are also recorded. 25 trees identified among these 3 of them are small trees. Besides this 11 shrubs and 9 climbers are noticed. Asteraceae, paplionaceae are found dominant families in which 7 genera each reported in these families. Among the mangrove associates Cyperaceae plants are dominant.Indeed many such species that are culturally valued ecologically significant keystone value to the ecosystem, through their contribution to ecosystem integerity (Ramakrishnan *et al* 1998, 2000). The avifauna of the certain sacred groves of North Malabar including Thazekkavu of thekkumpad were reported (Sasikumar 2005)

The present study give an insight into the bio-ecological and socio cultural dimensions of sacred groves in helping and conserving the biological diversity. Kaliyattam a performing art with different forms of 'theyyam' is conducted every year offering to propitiate the deity by different communities in the villages. These festivals are socio-religious ceremonies performed in north Kerala since ancient time (Kurup,2004). The 'Devakooth' a theyyam performed by women in Thekkumpad kavu. is noteworthy among the performative rituals. These ritualistic practices centred around the sacred groves substantially contribute to the conservation and day- to-day management of ecological balance by sacred groves.Maritheyyam will be performed at Madayi kavu on the 16th day of Malayalam month karkidagam.

Sacred groves are the part of the socioecological system,the concept of village as part of a large cultural landscape, with interconnections between the various ecosystem type such as forests, water bodies and human-managed agroecosystem types placed within a resource rich landscape unit provideed the appropriate climate for sustaining protected forest ecosystems in the form of sacred groves.In other words, presence of resource rich healthier natural ecosystem type is a prerequisite for conservation of the sacred groves.

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BIO-ENERGY PRODUCTION FROM EXOTIC SPECIES AND SYNCHRONIZED CONSERVATION OF NATIVE BIODIVERSITY

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ABSTRACT

A survey was conducted to identify the level of awareness among people regarding problems caused by invasive exotic weeds to our biodiversity and sense to use the same productively. Biogas is increasingly being used as an alternate cooking fuel in selected areas of urban and semi-urban Alappuzha during 2014-15. Apart from survey visits, mass awareness programmes were also conducted to convey the potential and significance of usage of exotic weeds like *Eichhornia* for producing biogas at house hold level to deal with the twin issues that we face today ie. fuel depletion and rapid reduction of indigenous biodiversity.

The present study so far hints to the truth that the people of the current generation are severely over reliant on the fossil fuel, LPG. It was found in the survey that use of aquatic invasive weeds as major raw materials for biogas plants are not encouraged or implemented in each and every household. It is only because of the lack of understanding of importance of biodiversity conservation by the authorities concerned. In addition to production of green energy, roughly about two crores can be saved in revenue because that much amount is presently being spent for the ineffective efforts of removal of the weeds from our water bodies, every year. Such measures are described here as futile because the removed quantum of weeds make a come back with double the vigor in another three months of sunshine. After analyzing survey reports we suggest that, dried exotic weeds must be made available at affordable rates to individual households.

The greatest advantage of making use of exotic plant weeds as potential and constant source of bio energy is that inadvertently we are making way for the native biodiversity to flourish through. Besides we shall be able to extend our LPG cylinder for an extra month or two. This means not only energy savings but also sustainable use of undesirable vegetation on a long term basis. Such measures may not only help in accruing huge indirect monitory savings but also the awareness thus gained by citizens on biodiversity conservation can then be focused for understanding of natural ecosystems in a better way.

Keywords: Bio-energy production, biodiversity.

1. INTRODUCTION

Biogas is unique in several aspects when compared to its alternate fuel counterparts. The commendable factor that makes biogas unique is that its substrate is not only absolutely free (*kitchen waste and faeces*) but also something that we always wanted to get rid off, the bio-waste. So installing a biogas plant naturally becomes 'two birds in one shot' type of achievement. Probing further we come across the positive facts that it is non-explosive, non smoky flame, regulatable just like an LPG stove, tank available at subsidized rate, almost repair free, portable, no complicated technology, flame strength equivalent to that of LPG, one hour flame guaranteed for every 3 to 4 kg biowaste per day, space requirement not more than a normal water tank, any non-fibre and non-acidic biowaste can be raw material etc. Biogas is one of the most economical ways to cook or light a home in rural areas of the world when other power sources are unavailable.

Apart from guaranteed features, it has added benefits too. One of the added advantages of a biogas facility is that the unspent slurry is a rich source of nitrogen rich manure for vegetable crops. Since cow dung is required only during the initial stage; user is free from the menace of cattle breeding. Moreover, unpleasant odour of dung lasts for the first 3 or 4 months only. Another advantage revealed from our study is that the bio-energy tank in continuous use was found to retain its activity even after keeping idle for up to four months. This means the nuclear family who own an active biogas tank can go for anguish free holidays for months together! The greatest advantage for a budget family is that along with doing away with garbage, they are now able to save their LPG cylinder for an extra month or two. This means savings not only for them but the whole nation. Now in real quantitative terms let us see what the savings is in Indian rupee. Suppose you are a person using 8 LPG cylinders per

year. By using LPG it is reduced to 6. You straightly save approx. Rs. 800/- (*400 x 2*) for yourself and 600/- (*300 x 2 in terms of subsidy*) for the nation. Just multiply with crores of citizens and we happily arrive at the magic of biogas in bringing national level savings to the tune of multicrores which can be diverted for better infra structure across the country which as a natural byproduct of biogas usage, would have already become almost garbage free too.

This being the crystal clear truth however, according surveys conducted by us during 2012 and 2015, initiative from the governing bodies could only increase the percentage of biogas users from 0.6 during 2010 to a meager 1.2 after a span of five years. At the same time households who wish to install a biogas tank in their premises has increased from 68 to 79 per cent.

Future prospects of this investigation suggest a modified version of biogas usage for urban users and flat dwellers which involve cultured vials of anaerobic methanogenic bacteria developed through research.

1.1. Relevance of the study

Biogas is one of the first programmes undertaken by Malanadu Development Society. No systematic evaluation of the programme has yet been made till date. There are also other biogas implementing agencies in the Governmental and Non-governmental sector. Comparative efficiency of these agencies needs to be evaluated. The study makes an attempt to enquire into the strengths and weaknesses in implementing the programme. Another relevance of the study is that biogas programme is popularly believed to have deeply influenced energy and agricultural sectors. This study provided an opportunity to verify the basis of such popular notion. Looking at biogas programme as an activity of local change, the study makes an effort to find out the options of replicability and scaling up of the biogas programme. It is hoped that the study will bring forth useful clues that can go a long way in improving agriculture in Kerala, especially in the highranges of Kerala. It gives MDS, other NGOs, Panchayaths and Research Institutions useful insights on sustainability, replicability and scaling up the programme and draw lessons from it for the whole of Kerala.

1.2. Brief history of the Biogas Programme in India

Biogas has a known history of slightly more than 100 years of application in India. The most prominent milestones in biogas extension in India are given below vide table 5 Table 5- Milestones in Biogas Development in India No Year Experiments, innovations and findings 1 1897 Bombay Experiment Ackworth Leper Home Matunga, Bombay; Biogas from septic tanks was used for lighting 2 1907 Ackworth Leper Home Matunga, Bombay; Operated an engine generator with biogas as well as gas used for cooking 3 1920 Calcutta Experiment. Dr Pal and Dr Ghosh of the University College of Scienceand Technology. Biogas produced from water hyacinth 4 1923 Waste materials like banana peals, leaves etc used as feed materials at the experiments conducted by Dr. Joshi and Dr. Fowler at Indian Institute of Science – Bangalore. 5 1937 IARI Experiment by Dr S.V Desai. Cow dung used for gas production 0.6cubic foot gas/pound of dung. The Dadar sewage purification plant based on biogas fermentation method set up at Bombay 6 1944-45 MrM.Renaudot's Experiment Cattle dung and agro waste digester produced 15-25 cum gas/day and compressed gas used to run Tractors. 7 1946 Indian Agriculture Research Institute designed the first family size biogas plant 8 1949 Mr Jashbai Patel Experiment with the development of the forerunner of the KVIC plant. Osmania University, Hyderabad Negotiable cover used as gasholder for the first time Input=30l kg dung+30l litre water Capacity=20cubft gas/day 9 1952 Development of the floating drum type biogas plant. It was named 'Grama Laxmi- III' by Jashbai Patel, a Gandhian worker from Gujarat. 10 1961 KVIC adopted biogas programme for dissemination, deciding to disseminate the model of Gramalakxmi-III. PRAD- Planning Research and Action Division (PRAD), a separate division under the UP State Planning Board sets up GGRS- Gobar Gas Research Station at Ajitmal in UP. 11 1963-64 `KVIC began providing financial assistance to farmers in constructing biogas plants. This was a departure as it used to support only khadi institutions to construct biogas plants in the period 1961-63. 12 1967 KVIC completes 10,000 biogas plants 13 1974 60,000 plants completed. An impact assessment of biogas programme made and Government of India takes up implementation of biogas programme in right earnest. 14 1977 Janatha biogas plant with a fixed dome designed and constructed by GGRS, a wing of Planning Research and Action Division (PRAD) of UP State Planning Institute in their research station at Ajitmal in UP to overcome the disadvantages of the KVIC type – floating drum model 15 1981 NPBD- National Project on Biogas Development launched by Government of India. 16 1982 DNES- Department of Non-conventional sources of Energy created under the Ministry of Energy – Government of India. NPBD

brought under DNES. Biogas programme included in the 20 point programme of the Prime Minister. 17 1984 Deen bandhu biogas plant designed by AFPRO-Action for Food Production a Delhi based NGO. 18 1987 Government of India approves Deen Bandhu model Biogas Plants and extends subsidy benefit to it. 19 1992 DNES upgraded into a Ministry and named it as MNES

2. STATUS OF FOSSIL FUEL

Fossil fuels are fuels formed by natural process such as an aerobic decomposition of buried dead organisms .fossil fuels contain high percentage of carbon and include coal,petroleum and natural gas. It was estimated by the energy information administration that in 2007 primary sources of energy consisted of petroleum 36.0%,coal 27.4%,natural gas 23.0% amounting to an 86.4% share for natural fuels in primary energy consumption in the world

Non fossil sources in 2006 included hydro electric 6.3% nuclear 8.5% and others (geothermal,solar,tide,wind,wood,waste) amounting to 0.9% world energy consumption was growing about 2.3% per year.

Fossil fuels are non renewable resources because they take millions of years to form and reserves are being depleted much faster than new ones are being made .the production and use of fossil fuels raise environmental concerns.a global movements towords the generation of renewable energy is there for under way to meet increase the energy needs.the burning of fossil fuels produces around 21.3 billion tones of CO2 per year ,but it is estimated that natural processes can only absorb about half of that amount,so there is a net increase of atmospheric CO2 per year .CO2 is one of the green house gases that contribute to global warming ,causing the average surface temperature of the earth to raise in response,which the vast majority of the climate scientists will agree will cause major adverse effects

2.1. International Status

In developing countries cookers /stoves,lamps,refrigerators are appliances commonly fuelled by biogas .biogas can be converted to electricity using fuel cell, through this is still considered a research area due to the need for very clean gas and the cost of cells. In contrast using biogas to fuel a compution engine and in turn an electric renerator is a proven means of producing electricity, given the wide availability of suitable generators. For example in India a well studiedcommuity bio gas digester was used to fuel a modified diesel engine and run an electrical renerator.

Biogas burns with a clean , blue flame and stoves have been considered the best means of exploiting biogas in rural areas of developing countries .

Worldwide, effective and wide spread implementation of domestic biogas technology has occurred in countries where governments have been involved in the subsidy, planning, design, construction , operation and maintenace of bio gas plants. There are several such contries in asia, where in particular china and India have seen massive campaigns to popularize the technology . Surveys in various regions of India have the proportion of functional plant to be from 40% to 81% . It should be noted that although not always started, digester age is a significant factor in performance.

Up to half the UK's domestic gas heating could be met by turning waste into biogas , according to a report from National Grid . The report looks at how all the biodegradable waste streams such as sewage , food and wood could be turned into biogas and injected into the gas distribution system. At the moment there is a small quantity of production of biogas in the UK coming from land fill and sewage plants, but it is being used to generate electricity . The National Grid says these valuable waste resources could be used more efficiently by turning thenm into bioethane.This could meet 50% of the domestic gas needs and helps achieve renewable energy targets for 2020.

Compressed natural gas (CNG)as also biogas aare commercially used as vehicle fuel in New Zealand and Italy. Conversion kit for biogas fuelled vehicle is virtually the sme as for CNG which is marketed as an automotive fuel in many parts of the world .these kits permitschange over form gas to liquids fuel and vice versa at a short notice .As methane is only half of the weight of the air, dispersal of the leaking gas is faster .This makes biogas as safer fuel than either LPG or Pertorl. Ibadan ,the second largest city in Nigeria is the center of a large agricultural region in Oyo state . since the 19th century , fierce intertribal rivalries and other political unrest have pushed large influxes of refugee and military populations into the city. This chaotic growth has discouraged the kind of municipal infrastructure thatis taken for granded in the developed world.soon, however ibadan's power

needs at least will get a boost from a relatively simple but extremley finding favour across Africa : biogas. theibadan plant will be one of the larger biogas installations in Africa

Bengladesh is endowed with plentiful supply of renewable sources of energy. Out of the various renewable sources, solar and biomass and to a limited extend, wind and hydropower are effectevleyused.the effective source of renewable energy is biomass.Under this category improved stoves,biogas plant and biomass briquetting are note worthy. According to an official estimates there is a cattle population of 24 million and poultry population of 75 million. This can produce about 3m biogas. The Local Government Engineering Department (LGED)and IFRD are working to install the biogas plants in the r ural areas .So far a total of 19,596 plants have been installed.

2.2. National Status

India's consumption of energy is expected to double in the near feature. The national advisory board for energy in India has published a report forecasting the required quantity and the manner for supply of energy in the feature. The boards estimate that India has enough resources to sustain 16-22 Mio small biogas plants with $2m^2$ reactor volumes, each to supply sufficient energy for a farmer family with 4 cows

In plants in India, the substrate, cattle dung and biogenous waste, are manually mixed with water in a ratio of 10% dry matter to 90% water. The mix is filled in to the digester by simply pushing.The reactor is neither heaten not isolated ,enabling the fermentation process to take place at temperatures in the region of 14°C during winter and 25°C during summer.In the reactor itself , a substrate is mixed by a simple mixer which is operated manually. After a dwell time of the substrate in the reactor of around 100 days the fermented residues is removed with buckets or scoops.pumping systems are not used.In general , such a small biogas plant coast around 50000 Indian rupees per cubic meter of digester.The plants are constructed with the help of local artisans who receive a daily wage of 50 rupees.

The construction of more biogas plant has revealed several beneficial sideeffects.Such as a significant reduction in the exhaustive cultivation of forests.Unexpected success were noted in medical sector also .Since respiratory systems and eyes were no longer exposed to aggressive wood smoke fromefire,the number of cases of acute asthma and eye diseases was significantly reduced (Dieter Deublein and Angelika Steinhauser).

A metropolitan city like Calcutta daily accumulates 2000 tonnes of garbage which can be converted into biogas.12 kg of garbage produces 30 liters of methane gas in a mini mint.The coast of the plant is 3 lakhs production is still on an experimental basis. Daily 500 kg of garbage will produce 300 liters if methane. Mathene may be used as cooking gas or to genarate electricity or can be transformed into alcohol.

Biogas from the glue industry wastes is thought in India. For various reasons the Biogas plant programme has not yet gained great momentum in India. One of the reasons is the lack of requisite quantity of cattle dung.

Ther are a number of goshalas, dairies,and village communities having Large number of cattle, which have the potential for installing biogas enrichment and bottling system. In urban areas large quantity of biogas can be produced in sewage treatment plants using an aerobic digestion. The Okhlm sewage treatment plant in New Delhi is an example where more than 10000 cubic meters of biogas is produsedevery day. Due to rising cost of petroleum products and environmental concerns it has become imperative to make use of local resourcesas an altrnate to petroleum fules. Therefore it is worldwide trend to explore and make use of biogas as an alternat fuel (Biogas-enrichment and bottling technology for vehicular use, Dr:Virendrakumarvijay)

SolankiVijanbhaiMaldebhai runs a small milk processing plant in Junagadha district of Gujarat, buying and processing about 200 litres of milk daily. Processing of milk leaves a foul smelling liquid which is dificult to dispose. This was at time when AKRSP was trying to motivate people in village to motivate biogas plant. This innovative farmer who had adequate cattle decided to install and run a biogas plant on dairy waste. He apporached AKRSP staff and after some initial hestation, a biogas plant was constructed, which is operating completely on dairy waste. It take care of the cooking fuel needs and more importantly, helps him to dispose the foul smelling dairy waste in hygienic way (Biogas-The Indian NGO Experience, Somadutta *et al.*)

Biogas technology has been use in India for nearly a hundred years. However its dissemination began in a concreted manner only in 1981 with the launching of the National Project on Biogas Development (NPBD), and its subsiquentincluions in

the Primr Ministers Twenty –Point Programme. It further gained momentem with the3 establishment of the Department (now Ministry) of Non conventional Energy sources (MNES) in 1982.

The Minister adopted a decentrelized multi agency and multi model implimentationstategy for NPBD. At the state level programme is implimented through the nodal agency(Council for Science technology, Energy Development agency etc.) which is primarly responsible for achievingtargets, managing finances, monitering etc. other agencies involved in the implimentation at the district level and below are several government bodies such as District Rural Development Agency (DRDA), Block Development Office(BDO) local enterpreneurs, ruralnanogovernmental organizations (NGOs), gramapanjayath, dailycooperatives, etc.Further the National banks are also involved in the programme by providing soft loans to beneficiaries to partially meet the coast of construction.

To provide support to the implementation of NPBD, the ministry has created a network of 17 Regional Biogas and Training Centers (RBDTCs) across the country. These centers impart training and provide technical support to various groups of people involved in the implementation process. MNE has also setup an eight regional offices which provide guidance to the state nodal agencies and monitor the progress of the programme (Somadutta *et al.,* 2006)

Significant regional variations were observed in the fuel consumption levels across the country. The choice and level of use of particular fuel is governed primarily by its access to woody biomass. This in turn is determined by factors like local climate, vegetation type etc.

3. TYPES OF BIOGAS PLANTS

3.1. Brick Tanks

Tanks can be built from clay bricks. When preparing the ground for the tanks, the base must be particularly well rammed. For the base plant the following materials are applicable.

- Quarry stones with cement mortar filling and screed
- Brick work with screed or concrete

Bricking of curved bowl is simple. One needs only a center. E.g.: from a heap of stone, which is removed afterwards, and a radius stick. In contrast to this, concreting is more difficult because a flame work is necessary.

Brick work and mortar: Mortar and bricks should have about the same strength. Bricks of low quality require thicker walls.

Mortar for brickwork consists of sand, water and binding agents. Cement as binding results in smooth elastic mortar. In order to get good water proof brick work, a mixture of cement and lime should be used as binding agent. The sand for bioreactor brick work must be finally sieved. It must be clean and should not contain loam, dust, or organic components.

3.2. Reinforced concrete tanks

The reinforced concrete must be free of cracks and resistant under the special conditions during fermentation over the entire period of utilization.

With reinforced concrete, the acidic substrate, can penetrate to the reinforcement and corrode if CO_2 containing air also penetrates to the reinforcement. CO_2 converts calcium hydroxide in the concrete to calcium carbonate. The pH value in the concrete around the reinforcement's decreases to values below 9 and the steel begins to corrode.

In order to prevent such damage, the local laws stipulate a quality supervised concrete with high resistance to strong chemical attack when the concrete is exposed to pH value below 4.5 over longer periods. The parts of structure can consist of water – repellent concrete with high frost resistance.

3.3. Tanks of normal steel metals with enamel layer or plastic coating

An enamel layer protects the entire steel surface durably. It is glass like and extremely resistant.

Such tanks are completely pre fabricated from steel sheet segments. For enameling, the segments are prepared in different dipping baths. ie., cleaned, derusted etc. Then the enamel powder is blown on in an even layer, in the klin (the heart of an enamel factory), the powder coated single metal is heated up to 860°C so that enamel powder melts and forms a strong bond with the surface of a metal. The single metal sheets are connected together by means of special screws. Such tanks are easy, fast and safe to construct.

3.4. Tanks of stainless steel

Stainless steel tanks usually consist of welded stainless steel of the quality 1.4301, 1.4404, 1.4436, 1.4435, 1.4571, but they are occasionally

built from stainless steel plates screwed in to a steel structure made up of hot galvanized profiles. The plate segments are sealed to each other with methane - gas tight elastic PU sealing bands. Screws, nut etc have to be made from stainless steel.

According to the elastic requirements, such tanks have either curved covers or flat covers with appropriate stiffening. In the latter case a static proof has to be adduced.

3.5. Fixed type biogas plants

In fixed type biogas plants which first developed in China, gas is stored in the upper part of the digester. In this design there is no separate gasholder and upper portion of the digester pit itself acts as gasholder. Displaced level of slurry provides requisite pressure for release of gas for its subsequent use. The plant works on both plant waste and animal waste materials and is convenient work within both continuous and batch mode. Normally animal wastes are fed daily whereas residues are fed in batches. As the plants does not involves any steel parts and it can be built with local materials, its construction costs are low and operation cost virtually nill. Beingunderground, space needs are also minimal Materials like lime – clay, lime – concrete, concrete, bricks, stones etc can be used for plant construction.

Based on Chinese design, Gobar Gas Research station developed the first ever fixed dome biogas plant in India in 1922 which was come to be known as Janata plant. It involves an underground cylindrical digester and a hemi spherical dome but without man hole cover. The dome is fitted with a GI pipe through which the biogas is taken out. It is made of bricks, cement and concrete. Following construction, digester walls and dome are cured for several days for imparting requisite strength to the plant.

3.6. Movable 'drum' type plant

It basically comprises an underground brick masonary digester connected with an inlet and outlet and covered by a movable steel gasholder for gas collection. Gas holder moves up and down guided by a central guide pipe depending upon accumulation and discharge of gas. Movable gasholder made of mild steel alone accounts for some 40% of the total plant cost and accordingly these plants are much more expensive than fixed dome type. Maintenance costs of these plants are also high in view of much the need to paint gasholder every year to prevent corrosion. Based on series of chronological developments in India, JARI and KVIC developed two plant designs which have come to be known as the IARI and KVIC models.

3.7. 'Deenabandhu' biogas plant

Action for food production (AFPRO) an NGO in 1984 developed a low cost fixed dome plant called Deenabandhu model meaning friend of the poor. It ia appropriate for using all types of wastes and minimizes biogas losses from inlet chamber and ensures maximum utilization of digester volume there by making the plant operates at designed HRT. t is 30% cheaper than Janata model. Storage capacity is 33% of daily gas production. It has curved bottom and a hemispherical top which are joined at their bases with no cylindrical portion in between. Displaced slurry following fermentation moves to the outlet displacement chamber as there is no displacement space on the inlet side. An inlet pipe connects mixing tank with the digester.

Cattle dung slurry prepared in 1:1 ratio with water is fed up to the level of second step in the outlet tank which is also the base of the outlet displacement chamber. As the gas generates and accumulates in the empty portion of the plant, it presses the slurry of the digester and displaces it into outlet chamber it starts rising. This fall and rise continuous till the level in the digester reaches the upper end of the outlet opening, and at this stage the slurry level in the outlet tank reaches the height of discharge opening. Any unused gas beyond this stage escapes through the outlet tank.

3.8. 'GAYATRI' MODEL

Gayatri model was developed by Govt: implements factory Bhubaneswar. It eliminates the use of brick dome; a pre- fabricated fiber glass reinforced plastic (FRP) dome of the same dimension is used for gas collection.

3.9. 'TNAU' Model

Tamil Nadu agricultural university at Coimbatore evolved 4 the designs of biogas plants with a view to achieve among other reduction in retention period. One of its model is similar to the fixed dome plant of the Janata type with a flat bottom where as the other model resembles the Nepalese version of the Chinese model with curved digester bottom and Ferro-cement dome. Special feature of the plant is low retention period of 15 days which is achieved by periodic addition of microorganism which speed up the digestion process.

3.10. 'KRISHNA' biogas plant

The plant consists of a digester with its dome and lower cylindrical portion cast monolithically in reinforced cement concrete (RCC). The inner surface of the structure that comes in contact with biogas under varying pressure is coated with an epoxy paint to prevent possible gas leakage. In addition a single compensatory slurry displacement tank also cast in RCC is provided over the dome to account for increase in gas pressure. The coast of the Krishna model is lower than the KVIC model.

It is possible to connect a latrine unit to the biogas plant so that night soil could be digested along with the cattle dung.

3.11. 'MANIPAL' model

This model has features of both Indian and chinese models. It has a rectangular digester with an inclined RCC roof. There is no separate gasholder unlike in earlier Indian designs and larger inclined space above the slurry level provides storage area for resulting biogas to accumulate. Digester can be built particularly inside or fully above ground depending uponground conditions variation in pressure is achieved a shallow ferro-cement cover dipped in water seal on sloping roof slabs. Intlet pipes are selected according to the feed material availability and desired mode of plant operation. Resulting biogas is taken out with the help of a pipe.

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DOCUMENTATION OF ABORIGINAL TRADITIONAL KNOWLEDGE AND INHERENT INDIGENOUS THERAPEUTIC PLANTS OF COIMBATORE DISTRICT, TAMIL NADU, INDIA

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ABSTRACT

The aim of the study was to investigate the medicinal plants used as therapeutic, nutritive and food additives which are consumed by the tribes of Coimbatore district, Tamil Nadu, India. The information was gathered from the local tribal community people, an aboriginal community who reside in the foothills, around the Coimbatore district. Several field visited to the tribal inhabitant areas to collect data on medicinal and aromatic plants commonly used by them. The observations collected during field visits were put to group discussion. The medicinal plants were identified, photographed and sample specimens were collected for preparation of herbarium. The results of the study have been documented that 47 plants belonging to 24 families and 38 genera used to treat wound healing, diabetics, jaundice, skin diseases, gastro intestinal disorders, ulcer, fever, cold, cough, bronchitis, ring worm, snake bites, burns healing, eye diseases, swelling, rheumatism, cosmetics and also used for malnutrition.

Keywords: Ethnobotanical knowledge, indigenous, therapeutic plants.

1. INTRODUCTION

Since time immemorial man has used various parts of the plants in the treatment and prevention from many diseases (Chah *et al.*, 2006). The ethnomedicinal systems and herbal medicines are therapeutic agents in addressing health problems of traditional communities. Historically all the medicinal preparations were derived from plant parts having more complex of crude mixtures, which are active against a variety of diseases (Ayyanar and Ignacimuthu, 2009). This knowledge and wisdom includes healing traditions which have helped long for indigenous communities to maintain their personal health and wellness (Buenz, 2005). The medicinally important plants were identified to be used by ethnic people to cure various ailments such as diabetes, dysentery, fever, headache, rheumatism, snake bite, cough and some as food and food additives (Samydurai *et al.,* 2012).

Plants used by the tribal people for treating rheumatism (Ayyanar and Ignacimuthu, 2005). Most of the tribes having traditional knowledge on medicinal plants that are used for primary health problems such as cough, cold, fever, headache, poisonous bites and some other simple diseases (Sutha *et al*., 2010). Certain wild tubers, root types, green leaves, flowers, unripe as well as ripe fruits, grains and legumes including tribal pulses are consumed by different tribal sects (Jain, 1981; Maikhuri *et al.,* 2000). The tribal societies are closely associated with the forest ecosystem where they live in tradition and harmony (Kadavul and Dixit, 2009). Huge amount of medicinal plant species are used by ethnic people for the various skin diseases like eruptions, eczema, leucoderma, sores, cracks, cuts, boils, wounds, external tumors and body pain, swellings (Reddy *et al.,* 2010) and these diseases curative plants derive their daily needs from various plants growing around them. The indigenous groups possess their own distinct culture, religious rites, food habit and a rich knowledge of traditional medicine (Anuradha *et al.,* 1986; Harsha *et al.,* 2002).

Even today globally, about 85% of the traditional medicines used for primary health care are derived from plants (Farnsworth, 1998). Humans have developed knowledge of using available plants to treat a number of ailments based on different medicinal systems such as Ayurveda, Unani and Siddha (Meena, 2009). In India it is reported that traditional healers used 2500 plant species among that 100 species of plants serve as regular source of medicine (Pei, 2001). During the last few decades there has been an increasing interest in the study of medicinal plants and their traditional use in different parts of the World (Lev, 2006). Nowadays the urbanization leads the fast vanishing of traditional knowledge on the use of plants by tribals, so urgent need to document the

medicinal plant knowledge otherwise it will be lost (Arinathan *et al.,* 2007). Recently, considerable attention has been paid to utilize eco and bio-friendly plant based drugs for the prevention and cure of different human disease (Ganesan, 2008). In our present investigation enlightened many of the important medicinal plants, which are needed to be document for therapeutic utilization in future.

2. METHODOLOGY

Frequent field surveys were carried out in and around Coimbatore hilly regions during June 2015 - June 2016 in various seasons. The ethnobotanical data (local name, medicinal uses and mode of consumption) were collected through interviews and discussions among the tribal practitioners around the study area. The curative plants were identified based on local names, photographs and sample specimens were collected for the preparation of herbarium. The collected specimens were identified taxonomically using The Flora of Presidency of Madras (Gamble, 1935); The Flora of Tamil Nadu and Carnatic (Mathew, 1983) and the following references Nair and Henry 1983; Henry *et al.*, 1987; Chandrabose and Nair, 1988; Gamble, 1996. Voucher specimens have been deposited in the form of herbarium, Department of Botany, Nirmala College for Women (Autonomous), Coimbatore, Tamil Nadu, India.

2.1. *Study area*

The tribal inhabitants are in the Coimbatore district which is part of Southern Western Ghats of Coimbatore district. The following areas of northwest fields of Boluvampatty Range, Palamalai, Anaikatty, Maruthamalai and southwest regions of Siruvani and Anaimalai hills. Irula tribes are still using plants for their livelihood by consuming whole plants, leaves, roots, rhizomes, and tubers. They are also occupied in seasonal collection of honey, bee wax, fire woods and some minor forest products.

3. RESULTS

Coimbatore mountainous region have a variety of medicinal plants which are used by the Irula tribals for their primary healthcare and food security. The survey of 47 ethnic community curative plants species belongs to 38 genera and 24 families reported to be employed in the treatment of various skin diseases, wound healing, injuries like cuts, burns, bruises, sores, leprosy, itching, stimulants, carminatives and expectorants. The plants like *Acalypha indica*, *Aloe vera*, *Calotropis gigantea*, *Cleome viscosa*, *Euphorbia hirta*, *Morinda citrifolia*, *Pongamia pinnata* and *Vitex negundo* are commonly used by them.

Table 1. The enumeration of curative plant species used by the tribal community of Coimbatore district, with their family, local name, part used and medicinal uses.

S. No.	Botanical name	Local name	Habit	Family	Part Used	Ethnomedicinal uses/mode of consumption
1	*Acalypha indica* L.	Kuppaimeni	Herb	Euphorbiaceae	Whole plant	Itching, Skin diseases, Rheumatoid arthritis and scabies.
2	*Allmania nodiflora* (L.) wt	Thoikeerai	Herb	Amaranthaceae	leaves	Leafy vegetable
3	*Aloe vera* (L.) Burm.f	Sotru katrallai	Herb	Liliaceae	Whole plant	Amenorrhea, wounds, ulcers, burns, colic, hepatitis, skin diseases, constipation, tumor, malignancy, low back pain, edema, arthritis and general debility.
4	*Alternenthera paronychioides* A. St.-Hil.	Ponnanganni	Herb	Amaranthaceae	Leaf	Leafy vegetable
5	*Alternenthera sessils* L. DC	Ponnanganni	Herb	Amaranthaceae	Leaf	Gastrointestinal disorder, improve the male sexual potency. The weed is sometimes used topically to treat acne and eaten as vegetables.
6	*Andrographis paniculata* Wall ex Nees	Nilavempu	Herb	Acanthaceae	Whole plant	Bitter tonic and febrifuge, blood purifier, cure for torpid liver and jaundice and diabetic.
7	*Anisomeles indica* L. Kuntze	Peimeratti	Woody shrub	Lamiaceae	Whole plant	Analgesic, anti-inflammatory, skin problems and snake bite.
8	*Aristolochia indica* L.	Aaduthinnapalai	Climber	Aristolochiaceae	Leaf	Poison bite, skin diseases, intestinal worms, colic, arthritis and ulcers.
9	*Azadirachta indica* A. Juss.	Vembu	Tree	Meliaceae	Bark, leaves, flower and	Skin diseases, eczema, fever, wound, ulcer, burning sensation, tumor, worms, cough, diabetes,

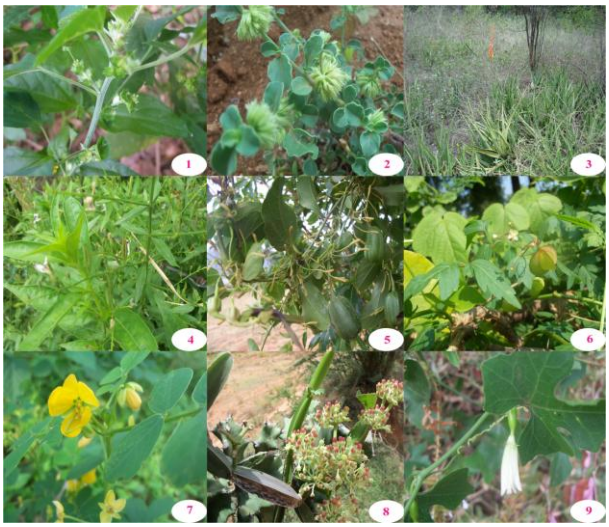
					seeds.	inflammation and rheumatoid arthritis.
10	*Calotropis gigantea* R.Br.	Yeruku	Perennial shrub	Asclepiadaceae	Root, Latex, Flower and Leaves	Skin diseases, joint inflammations, snake poison, asthma, chest infections, rabies and its strong purgative drug.
11	*Canavalia virosa* (Roxb.)	Thamatta	Climber	Papilionaceae	Fruit	Young fruits used as vegetables.
12	*Centella asiatica* (L.) Urban.	Vallarai	Herb	Apiaceae	Whole plant	Health tonic and memory enhance
13	*Capparis zeylanica* L.	Adondai, atontai	Climbing Thorny shrub	Capparidaceae	Fruit	Sedative, stomach, anticholerin, diuretic febrifuge, piles and swellings.
14	*Caralluma adscendens* (Roxb.) R.Br.	Kallimulliyan	Succulent herb	Asclepiadaceae	Whole plant	Antidiabetic, chronic illnesses and diet control.
15	*Caralluma fimbriata* (Roxb.) R.Br.	Kallimulliyan	Succulent herb	Asclepiadaceae	Whole plant	Antidiabetic, obesity, appetizer and heart disease.
16	*Cardiospermum halicacabum* L.	Mudakathan	Climber	Sapindaceae	Whole plant	Constipation, fever, amenorrhea, low back pain and rheumatism.
17	*Cassia tora* L.	Tagarai	Herb	Fabaceae	Seeds and leaves	Leprosy, ringworm, itching,snake bite and arthritis
18	*Cassia occidentalis* L.	Ponna virai	Herb	Fabaceae	Root, seed and leaves.	Cough, bronchitis, allergy, asthma, fever constipation, diabetes, skin diseases, wounds and ulcers.
19	*Celosia argentea* L.	Pannai keerai,	Herb	Amaranthaceae	Leaves	Leafy vegetable used as antidiarrhoeal, antibacterial and cooling.
20	*Ceropegia juncea* Roxb	Pulichan	Climber	Asclepiadaceae	Whole plant	Tranquilizer, hypotensive, hepatoprotective, antiulcer, and antipyretic.
21	*Cissus quadrangularis* (L.) Wall. *ex* Wight	Perandai	Climber	Vitaceae	Young leaf	Piles, osteoporosis, anorexia and fracture.
22	*Cleome viscosa* L.	Naaikkadugu, Kattu kadugu	Annual herb	Capparidaceae	Whole plant	Intestinal worms, colic, stomach upset, cardio myopathy, diarrhea, fever and dyspepsia.
23	*Coccinia grandis* (L.) Voigt	Kovai keerai	Climber	Cucurbitaceae	Leaf and Fruit	Constipation, burning sensation, leucorrhea, skin disease, fever, asthma, cough and jaundice.
24	*Decalepis hamiltonii* Wight and Arn.	Mahali kizhangu	Climber	Asclepiadaceae	Tuber	Appetizer, blood purifier, diabetics, indigestion and health tonic.
25	*Digera muricata* (L.) Mart	Thoikeerai	Herb	Amaranthaceae	Leaf	Astringent, laxative, diuretic and urinary discharges.
26	*Dioscorea alata* L.	Vetrilaikodi kizhangu	Climber	Dioscoreaceae	Tuber	Tuber used as stable food and nutritive.
27	*Dioscorea oppositifolia* L.	Kavala-kodi	Climber	Dioscoreaceae	Tuber	Tuber used as stable food, diarrhea, dysentery, indigestion and urinary discharges.
28	*Eclipta prostrata* L.	Mangal karisilakanni	Herb	Asteraceae	Whole plant	Reduce pain, promote hair growth, stimulate the functions of liver and ulcers.
29	*Euphorbia hirta* L.	Ammani paccharichi	Herb	Euphorbiaceae	Whole plant	Asthma, skin diseases, fever, cough and dysentry.
30	*Hemidesmus indicus* (L.) R.Br	Nannari	Climber	Asclepiadaceae	Root	Health tonic, diabetic, bronchitis, asthma, diarrhea, dysentery, arthritis, fever and general debility.
31	*Leucas aspera* Spreng	Thumbai	Herb	Lamiaceae	Leaves, Flowers	Inflammation, worm infestation, arthritis, cough, amenorrhea, intermittent fever and ulcer.
32	*Morinda citrifolia* L.	Nunamaram	Tree	Rubiaceae	Fruit Pulp and bark	Cough, fever, diabetes, swelling, analgesic, diarrhea and diuretic.
33	*Mucuna pruriens* (L.) DC.	Punaikkali	Climber	Fabaceae	Fruits, Leaves,	Constipation, impotency, Parkinsonism, kidney diseases,

					Seeds, Hairs	neuropathy, worm infestations, fever and general debility.
34	*Ocimum sanctum* L.	Thulasi	Under shrub	Lamiaceae	Whole plant	Cough, asthma, bronchitis, fever, toxins, vomiting, lumbago, gastric distension, genito-urinary diseases, ringworm and skin diseases.
35	*Pongamia pinnata* (L.) Panigrahi	Pongan	Tree	Fabaceae	Leaves, bark and Seed	Ringworm and skin diseases.
36	*Phyllanthus amarus* L.	Keelaanelli	Herb	Euphorbiaceae	Whole plant	Antispasmodic, antipyretic, diuretic, antiviral, and bactericidal.
37	*Phyllanthus retieculatus* Pori.	Neerpula	Herb	Euphorbiaceae	Whole plant	Diabetes, hepatitis, burning sensation, burns, skin diseases, obesity and urinary retention.
38	*Phyllanthus urinaria* L.	Senkeezhnelli	Herb	Euphorbiaceae	Whole Plant	Diuretic, diabetes, hepatitis, astringent, anti-inflammatory, jaundice, indigestion, chronic dysentery and urinary tract diseases.
39	*Premna corymbosa* R.Z Willd	Minnai	Small tree	Verbenaceae	Tender plant and leaves	Carminative, galactagogue, neuralgia, rheumatism, flatulence and colic.
40	*Rawvolfia serpentina* (L.) Benth. *ex* Kurz	Sarpagandha	Shrub	Apocynaceae	Whole plant	Snake bite, blood pressure,
41	*Solanum nigrum* L.	Manathakkali	Herb	Solanaceae	Whole plant	Swellings, cough, asthma, arthritis, inflammation, skin diseases and anti cancer drug.
42	*Solanum surratensis* Burm. F	Kantankattiri	Shrub	Solanaceae	Fruit	Stimulant, expectorant, diuretic, laxative, febrifuge. cough, bronchitis, asthma, enlargement of liver and spleen, vomiting.
43	*Solanum xanthocarpum* Schrad. and H. Wendl.	Kantankattiri	Shrub	Solanaceae	Whole plant	Worm infestations, dental caries, inflammations, arthritis, colic, flatulence, rheumatoid arthritis, cough, fever, asthma, bronchitis, amenorrhea, low back pain, hemorrhoids, epilepsy and kidney stones.
44	*Strachy nux-vomica* L.	Yetikai	Tree	Loganiaceae	Seed	Cardiomyopathy, hypotension, arthritis and dementia. In large doses, all part of the tree is toxic.
45	*Tinospora cordifolia* (Willd.) Hook. f and Thomus	Seenthilkodi	Climber	Menispermaceae	Leaf and fruit	Burning sensation, rheumatoid arthritis, gout, cardiac debility, skin disease, anemia, cough, jaundice, oligospermia and urinary diseases.
46	*Utleria salicifolia* Bedd. *ex* Hook fil	Chedi magali	Shrub	Peripolocaceae	Tuberous root	Indigestion, asthma, leprosy and diabetics
47	*Vitex negunda* L.	Nochi	Large shrub	Verbenaceae	Leaves	Arthritis, inflammations, lumbago, dyspepsia, colic, flatulence, wounds, ulcers, bronchitis, cough, malarial fever, leprosy and general debility.

Aristolochia indica, Andrographis paniculata, Azadirachta indica, Rawvolfia serpantina, Strychnos nux-vomica, Anisomeles indica, Ocimum sanctum, Leucus aspara applied for snakebite and *Phyllanthus niruri, P. reticulatus, P. urinaria* are orally administered to cure jaundice, liver pain. Many of the ethnic communities daily sources of leafy vegetables include *Cassia tora, C. occidentalis, Premna corymbosa, Allmania nodiflora, Celosia argentina, Tinospora cordifolia, Cissus quadrangularis, Eclipta prostrata, Alternanthera sessils, A. paonechoides, Cardiospermum halicacabum, Cocacinia grandis, Digera muricata, Centella asiatica, Ceropegia junceae, Caralluma adscendens, C. fimbriata and Canavalia virosa, Capparis zeylanica, Mucuna pruriens, Solanum xanthocarpum, S. nigrum, S. surattensis* plant fruits used as vegetables. Most of the root, rhizome and tuberous plant of *Dioscorea oppositifolia, D. alata, D. hamiltonii, Utleria salicifolia* and *Hemidesmus indicus* are grown in wild and hence complimentary the ethnic people collect them for food and health tonic. Some of the ethnic men are gathering wild honey as a source of income for their daily life span.

Majority of the herbal remedies are taken orally, the dosage given to the patient depends on

age, physical status and health conditions of tribal children. Before starting the treatment, the condition of the patient is observed deeply and then the prepared medicines are given to treat diseases. For topical, the most important methods used are direct application of the plant paste and mostly deals with ailments like skin diseases, wounds, poison bites, rheumatism, body pain and headache. Some of the ailments are treated by internal consumption as well as therapeutic application such as poison bite, rheumatic and body pain. In some of the sickness such as cold, cough, fever and headache inhalation is also involved. Tribal practitioners are using specific plant parts and definite dosages for the treatment of diseases.



Figs. 1-9. Inherent indigenous therapeutic plants of Western Ghats part of Coimbatore region. 1. *Acalypha indica* 2. *Allmania nodiflora* 3. *Aloe vera* 4.*Andrographis paniculata* 5.*Aristolochia indica* 6. *Cardiospermum halicacabum* 7. *Cassia occidentalis* 8. *Cissus quadrangularis* 9. *Coccinia grandis*.

4. DISCUSSION

In the present investigation 47 plant species were found to be used by the tribes of traditional medicinal system for the treatment of various diseases like skin diseases, wound healing, stimulant and expectorant .The different parts of the plant such as leaves, fruits, roots and bark are used as food and medicine. Paliyar tribes inhabiting the Anaimalai hills are used 55 species of plants for the treatment of various ailments, food, cultural, traditional and religious ceremonies (Sivakumar *et al*., 2003). Muthukumarasamy *et al*. (2003) reported that Paliyar tribes using 21 medicinal plants to get relief from gastro-intestinal disorders and the information was collected from the elderly and experienced persons practicing indigenous medicines. Rajendran *et al*. (2003) surveyed the tribes inhabiting area, to collect the information on ethnomedicinal plants used by them for their primary healthcare and the survey enumerated 43 species of plants with multiple ethnomedicinal properties.

Local traditional healthcare practitioners used it to treat various ailments such as vomiting and dysentery (Ravishankar and Henry, 1992). Aboriginal community tribes mainly used 13 *Phyllanthus* species in different diseases like anemia, diabetes, malaria, tuberculosis, whooping cough, diuretic, jaundice, HIV, asthma, purgative, fever and headache (Lakshmi Narasimhudu and Venkata Raju, 2013). Rural people also used medicinal plants as traditional medicine for scabies, diarrhoea, urinary trouble, kidney stone, constipation and arthritis (Desale *et al*., 2013). Recent reports of ethnomedicinal knowledge of traditionally used edible leaves, seeds, roots and bark are used for primary healthcare problem such as fever, cough, headache, body pain and also as an energy tonic (Solomon Raju and Venkata Ramana, 2011; Samydurai *et al.,* 2012; Alagesaboopathi, 2014). Most of the medicinal plants are used by the herbal practitioner to treat common ailments for diuretic, snake bites, jaundice, piles, ulcer, swellings, weight loss, diabetics, cough and cold, body pain, diarrhea as anti-inflammatory and anti-cancerous. The traditional knowledge of ethnomedicinal plants and their therapeutic practices among Irula tribals may be helpful to improve the future pharmaceutical applications (Kalaiselvan and Gopalan, 2014). The study reveals that the herbs collected from forests and farmlands are used to cure the common ailments used medicinal plants by aboriginal people have been the custodians of forests and have sustained healthy life-styles in an eco-friendly manner (Pradheeps *et al.,* 2015).

5. CONCLUSION

During the interviews, discussions among the ethnic communities, traditional healers and local people around the Coimbatore district of Tamilnadu, revealed that the area is rich in medicinal plant diversity and the most popular mode of preparation of drugs including decoction, infusion, paste, juice, powder and also in the form of vegetables. This study reveals that ethnic community people and traditional healers generally depend on the forest resources for medicinal plants to treat various ailments.

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HEAVY METAL DETECTION FROM SEWAGE IRRIGATED SOIL BESIDE RAILWAY TRACKS IN MUMBAI

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ABSTRACT

There are more than 100 local train stations in Mumbai and suburban areas which are connected to each other through railway comprising 4 major lines. Each route contains slow and fast tracks running. On the adjacent side of these routes are small patches of land which are used for cultivation. The railway authorities give these lands for farming of some leafy and non-leafy vegetable crops. Majority of these lands are irrigated by the open sewage lines which run besides and parallel to the railway tracks and they bring many unwanted chemicals which are absorbed by plants to more or less extent. The water in these sewer lines comes from domestic, commercial and other sources. The present study deals with quantification of Pb, Zn, Cd, Hg, Ar and Cu from soil sample using laboratory methods. The results indicated a low to medium level of pollution of these in soils, except some of the areas where it is high. The Pb, Ar and Cu were common pollutants near many stations and occur in comparable amount whereas Cd and Zn occur near fewer stations and also in less to medium quantity and Hg contents were found to be the least. The results indicate that though the sewage water can be used for such sewage farming, the water quality should be monitored continuously for heavy metals and other form of pollutants to ensure safety for vegetable consumption.

Keywords: Heavy metals, Railway tracks, Sewer lines, Sewage farming.

1. INTRODUCTION

1.1. Sewage farming in India

Scarcity of sewage treatment plants and increasing sewage generation are a big problem for disposal of waste water. In such cases a significant portion of waste water ends up into river basins and is used for irrigation. It is many times bypassed in sewage treatment plants and sold to nearby farmers on charge basis by the Water and Sewerage Board. It has been reported that irrigation with sewage or sewage mixed with industrial effluents results in saving of 25 to 50 per cent of N and P fertilizer and leads to 15-25 % higher crop productivity, over the normal waters (Allen, 1973; Henry et al., 1954). In India major crops being irrigated with waste water are cereals, vegetables, flowers, avenue trees, garden plants, fodder crops, agro-forestry plantations and aquaculture (Basta, 1989). In Hyderabad along 10 km stretch of Musiriver, about 2100 ha land is irrigated with waste water to cultivate paddy. Wheat is irrigated with waste water in Ahmedabad and Kanpur. In New Delhi, various vegetables are cultivated on 1700 ha land irrigated with wastewater in area around Keshopur and Okhla STPs. In Hyderabad, secondary treated wastewater is used to irrigate public parks and avenue trees. In the villages near Hubli-Dharwad in Karnataka, tree plantation is done in similar way. (R. Kaur 1, S.P. Wani, A.K. Singh and K. Lal)

1.2. Farming beside Railway lines in Mumbai

The railway network in Mumbai consists of central, western, harbour and trans-harbour lines. The western line runs from Churchgate station to Virar and the central line runs from CST to Kalyan and beyond. The Trans-Harbour lines which connects the central and harbour line and the other line connects vasai road on western line to diva on central line and finally joins the harbour line. The central and the western line have slow train running tracks and also the fast train running tracks. The other lines have only slow train running tracks. On either side of all these tracks are patches of land which are owned by the railways and are given to crop growers for cultivation of various vegetable crops. This was done to promote vegetable cultivation and to protect the railway land against encroachment from slum dwellers. On the side of railway lines are sewage lines which run parallel to the tracks. The sewage lines are open and are cleaned by Municipal Corporation before the rainy season. The sewage lines not only carry sewage but also are meant to carry excess water during heavy rains in the rainy season which would otherwise disrupt the rail services and stop the major mode of transport and commute of local people. The sewage

in the railway sewage lines comes from the domestic waste of people living nearby. Also the city has number of shops beside the railway lines and also small manufacturing or processing units, slaughter houses, cloth washing units, paints and chemical making and supplying units, printing presses, cars and automobiles repairing shops, construction items suppliers, many residential quarters and complexes and majority of slums. The slums form a big population of the city and have a number of small industries and manufacturing units which manufacture many commodities that are sold in the local market or are sent to other towns and cities. All these constitute the industrial or commercial part which releases their waste, a part of which is released in the railway sewer lines. The farmers use these nearby drains and sewers to as a source of water to supply their farmland needs. They use diesel pumps to draw water from nearby drains to irrigate the farm when there are no rains. The farmers grow crops all year round. They grow vegetables like spinach, radish, fenugreek, lady's finger, red amaranth, and others. The farmers are mostly migrants and live in temporary shelters with their families or with farm workers in the railway farm without any basic amenities like electricity. The farmers use fertilizers, manures and pesticides for their crops. But mostly they depend on the water from sewers beside the railway tracks. The purpose of the study was to check the soil contamination due to waste water usage which contains commercial and domestic wastes. The heavy metals possess variety of toxic effects both on animals and plants.

1.3. Heavy metals and their affects on humans.

Arsenic can affect human health and is considered as one of the most significant environmental causes of cancer in the world (Smith *et al.,* 1999; 1997). There is a strong relationship between chronic ingestion of AS and deleterious human health effects. As exposure can occur from food, air and water, but major As poisonings have stemmed from water and this is usually the predominant exposure route. Exposure to As leads to an accumulation of As in tissues like hair, nails, skins resulting in clinical symptoms such as hyperpigmentation and keratosis. There is also an increased risk of skin, internal organ and lung cancers. Cardiovascular disease and neuropathy have also been linked to As consumption. Verbal IQ and long term memory can also be affected, and As can suppress hormone regulation and hormone mediated gene transcription. Increases in fetal loss and premature delivery, and decrease birth weights of infants can occur even at low (<10µg/L) exposure levels. Chronic As toxicity causes chronic lung disease like chronic bronchitis, chronic obstructive pulmonary disease and bronchiectasis, liver disease like non-cirrhotic portal fibrosis and other diseases like polyneuropathy, peripheral vascular disease, hypertension and ischemic heart diseases, diabetes mellitus, non-pitting edema of feet/hands, weakness and anemia (Guha Mazumder, 2008). Although Cadmium occurs in trace amounts in nature, it has been listed as substance dangerous to environment by WHO because it poses a risk of disturbing the balance of ecosystem along with metals like lead, mercury, copper, zinc, chromium, tin and silver. Cd is highly stable in environment and is accumulated in soil and living organisms (Terelak *et al.,* 1997). It is easily absorbed by plants, both through their root systems and by leaves, usually to its proportion to its concentration in the environment. Acid reaction of soil increases its mobility and availability (Kabata-Pendias, 1993). Cd remains in the tissues for a relatively long time and is accumulated in vital organs, especially in kidneys and liver. Cd is extremely toxic metal and has been responsible for many deaths. The symptoms of Cd poisoning are instantaneous hypertension, shortening of life-span; kidney damage, bronchitis, retardation of growth, gross abnormalities of the vital organs and risk to prostate cancer (Ullah and Enamul Haque, 2010). Zinc interferes with Cu metabolism. The symptoms of an acute oral Zn dose may provoke tachycardia, vascular shock, dyspeptic nausea, vomits, diarrhea and pancreatic, and damage of hepatic parenchyma. Although maximum Zn tolerance for human health has been established for edible parts of crops (20mg/kg) (Long *et al.,* 2003). Elevated levels of Copper in humans are associated with formation of acne, adrenal-cortical hyperactivity, increase in weight of adrenal glands, agoraphobia, hair loss, iron deficiency anemia's, anxiety, arthritis, osteoarthritis, retention of calcium in body, and predisposition of cells to cancerous change. Chronic Cu toxicity can result in liver disease and severe neurological defect (Janet *et al.,* 2005). Minimata disease due to Mercury poisoning has led to awareness about mercury toxicity. Fetus and children are more susceptible towards mercury toxicity. Mothers consuming diet containing mercury pass the toxicant to fetus and to infants through breast milk. Hg has been the cause of many disorders including cardiac, reproductive, genetic, nephrological and neurological. Recently heavy metal mediated toxicity has been linked to Alzheimer's, Parkinson's, Autism, Lupus and Amyotrophic lateral sclerosis (Farhana Zahir *et al.,* 2005). Repeated Lead exposures gives rise to abdominal pain, aggressive behavior, constipation,

sleep problems, loss of developmental skills in children, loss of appetite, fatigue, headaches, irritability, high blood pressure, anemia, kidney dysfunction, numbness or tingling of extremities and memory loss (Patrik, 2006).

These metals can enter the food cycle and food chain by entering into the plants which grow in such soil and finally to humans who consume such vegetables. The knowledge of such effects of heavy metals on humans and other animals and crops led at finding out the rough level of these metals in soil contaminated with sewage water and also at which locations they are above critical level.

2. METHODOLOGY

2.1. Study area

The area used for the study was the farm patches on western and central railway lines only. The western line starting from Churchgate to Borivali station and the central line starting from CST to Thane station. The western line stations where patches of such farms occur areLower Parel (Lp), Elphistone Road (Er), Dadar (Dr), Matunga Road (Mr), Mahim (Mh), Bandra (Ba), Khar Road (Kr), Santacruz (Sc), Ville Parle (Vp), Andheri (Ad), Jogeshwari (Jo), Goregaon (Gg), Malad (Ml), Kandivali (Kd) andBorivali (Bo). The area beside stations Churchgate, Marine lines, Grant Road, Mumbai Central, Mahalaxmi do not have such farm vegetation. The central line stations beside such sewage farming is done areCurry Road (Cr), Parel (Pr), Dadar (Dr), Matunga (Ma), Sion (Sn), Kurla (Ku), Vidyavihar (Vv), Ghatkopar (Gk), Vikroli (Vk),Kanjurmarg (Ka), Bhandup (Bd), Mulund(Mu) and Thane (Th). The stations on central line where such farming is not done are CST, Masjid, Sandhurst Road and Byculla. Only the stations mentioned above were chosen for the study, the railway line and the associated farms extend far beyond the stations mentioned. The farmlands on harbour and trans-harbour lines were not included in the study. The farms are actually situated beside the railway lines and spaces between any two stations. Some areas have big farms and some have smaller patches. Three to four soil samples were collected from the bigger vegetation patches in zip lock plastic bags and one soil sample was collected from each of the smaller patch. If the source of water was common, then only two soil samples were collected. The samples were properly labeled using stickers. Survey revealed many vegetable crops which are listed in (Table 1).

The soil collection was conducted from the September 2008 to January 2009 and was part of a minor research project funded by University of Mumbai. The analysis continued till the end of 2010.

Table 1. *Vegetable crops cultivated beside railway tracks in Mumbai*

S. No	Marathi local Name	English common Name	Scientific Name
1	Palak	Spinach	*Spinaciaoleraceae* L.
	Methi	Fenugreek	*Trigonellafoenum-graecum* L.
	Chawli	Green amaranth	*Amaranthustritis*
4	Ambaadi	Sorrel leaves	*Hibiscus sabdariffa* L.
5	LalMaat	Red amaranth	*Amaranthuscruentus* L.
6	Bhendi	Lady's finger	*Abelmoschusesculentus* L. Moench
7	Mula	Radish	*Raphanussativus* var. *longipinnatus*
8	Alu	Taro	*Colocasiaesculenta*L.

2.2. Soil samples

2.3. Soil treatment

The soil collected was brought to lab and spread on a tray and was kept for air drying on plastic sheets and metal pans. The different samples collected from the same farm or area or where the source of water was same were mixed together. The roots, stems, stubbles, and bigger stones were removed. The clogs of soil were broken with hand and later pulverized by a circular broad base hammer. The soil was passed through 2 mm mesh sieve after grinding. The soil was again kept for air drying. The soil was sieved through 0.05 mm sieve, 1.0 g soil was weighed and digested with 20 ml HCl to near dryness. The residue was dissolved in concentrated HCl and diluted to 25 ml. These prepared samples were used first for qualitative analysis of different metals. If the major tests were positive for particular metals, then they were further established for quantitative analysis (Table 2), (Amune *et al.,* 2012; Nagornyy, 2013; Basta, 1989).

Lead- In the alkaline medium, lead reacts with sulphide to form a brown precipitate of lead sulphide. This remains as a fine suspension whose intensity is read on a colorimeter at 440nm andis proportional to the amount of lead present in the sample.Standard stock lead solution 10mg/ml was prepared by dissolving 13.5 g of lead acetate in some

distil water, a drop of acetic acid was added to dissolve it, and the volume was raised to 1 litre with distilled water; standard working lead solution 0.1mg/ml was prepared by diluting 1 ml stock solution to 100ml. 5 ml of sample solution was taken and 2 ml of 1% NaOH and 0.5 ml of 10% sodium sulphide was added, the contents were mixed using cyclomixer and kept standing for 10 minutes. Absorbance was read on spectrophotometer at 440 nm. A series of test tubes with standard working lead solution ranging from 0.0, 0.5, 1.0….5.0 ml were estimated in the same way (Andrew, 1924; Bennet and Hudson, 1953).

Copper- The citric acid used acts scavenger and chelates out any other metal ions presents. Liquor ammonia serves to maintain pH at around 10. The copper ions solution forms a straw colored complex with SDDC which is extracted out in organic phase with iso-amyl acetate. Standard stock copper solution 0.1mg/ml was prepared by dissolving 251 mg of $CuSO_4$ in some distil water and the volume was raised to 1 litre using distilled water. Standard working copper soln5 µg/ml was prepared by diluting 5 ml stock solution to 100ml with distilled water. Carbamate solution 0.1% was prepared by dissolving 100mg sodium diethyl dithiocarbamate in 100ml 1% n-butanol. To 5 ml of sample, 1ml 15% Na-citrate buffer, 0.2ml liquor ammonia and 0.5 ml 1% sodium diethyl dithiocarbamate (SDDC) were added and volume was made to 6.7ml with DW. The contents of the test tube were mixed and kept for 10 minutes. Absorbance was read at 440nm, (Shah and Paul, 1972; Wing, 1982).

Zinc-Zinc-dithizonate complex in aqueous phase in the presence of sodium dodecyl sulphate anionic surfactant.Stock Zn solution (1g L-1) in 0.0085 M HCl was dissolved in minimum volume of 1M NaOH solution followed by 4 % SDS, finally the solution was acidified with dilute sulphuric acid. To prevent the oxidation of dithizone 0.5 ml of 0.72 molar hydroxylamine hydrochloridewas added and solution was kept at 10^0C. separately SDS 0.6 M was prepared in hot water below 20^0C, sodium acetate (0.2M) buffer solution was adjusted to pH 5 with acetic acid (0.2M), sodiumthiosulphate was added to mask interference. The volumes of stock solutions of Zn (II) ion with concentration 3×10^{-6} to 1.5×10^{-4} M was used. Dithizone 3.9×10^{-5} M and SDS 1.8×10^{-1} M. Absorbance was measured at 535 nm. For sample 5 ml volume was used and added to dithizone and SDS; (Shar and Bhanger, 2001).

Cadmium- Alizarin red S (1, 2-dihydroxy anthraquinone-3sulphonic acid sodium salt) reacts in slightly acidic solution (0.005-0.05M H_2SO_4) with cadmium to give deep greenish yellow chelate which has absorption maximum of 422 nm (Terelak *et al.,* 1997). (1.39×10^{-3} Mof Alizarine Red S solution was prepared, cadmium stock solution (1 $mgmL^{-1}$) was prepared by dissolving 0.228 mg of crystallized cadmium sulfate in deionized water, EDTA (0.01% W/v) was prepared, a 1% potassium permanganate solution was also prepared; stock solution of tartarate (0.01% W/v) was prepared by dissolving 10 mg of potassium sodium tartaratetetrahydrate in 100 ml deionized water; a 100 ml solution of aqueous ammonia was prepared by dilution 10 ml concentrated NH_4OH (30% ACS grade) to 100 ml with deionized water. To 0.1 – 1.0 ml of neutral aqueous with pH-6 solution containing 1-300 µg of cadmium in 10 ml in the flask was mixed with 1:5-1:110 molar excess (preferably 1.0 ml of 1.39×10^{-1} M) of alizarin red S reagent, which was followed by addition of 1 ml of 0.05 M sulfuric acid (pH 5.5-6.1). The mixture was diluted with deionized water and absorbance was measured at 422 nm; the sample used was 1ml (Terelak *et al.,* 1997).

Mercury - Diphenylthiocarbazone (dithizone) reacts in slightly acidic 50% aqueous 1,4-dioxane media (0.18-1.80 M sulphuric acid) with mercury to give an orange chelate which has an absorption maximum at 488 nm. Dithizone 1.56×10^{-3} M solution was prepared by mixing proper amount of diphenylthiocarbazone in known volume of triply distilled 1,4-dioxane. Standard stock mercury (II) solution 4.99×10^{-3} M by dissolving 135 mg of mercuric chloride in de-ionized water. Diluted standard solutions were prepared from this solution. Stock mercury (I) solution was prepared by treating 10 ml of stock mercury (II) solution with few crystals of hydroxylamine hydrochloride in 10 ml dilute sulphuric acid followed by removal of hydrochloride by boiling and dilution with deionized water to 100 ml. A 1% Potassium permanganate solution was prepared by dissolving in de-ionized water; sodium azide solution 2.5% w/v was also prepared. Tartrate solution 0.01% w/v was prepared by dissolving potassium sodium tartrate tetrahydrate in 100 ml de-ionized water. EDTA solution 0.01% w/v was also prepared by dissolving ethylenediamine-tetraacetic acid, disodium salt dehydrate in 100 ml of de-ionized water. A series of standard solution containing 1-250 µg of mercury (II) in a 10 ml volumetric flask and was mixed with 0.8 ml of 1.45×10^{-3} M of the diphenylthiocarbazone reagent solution followed by the addition 0.1 ml of sulphuric acid (0.45 M). After 1 minute, 5 ml of 1, 4-dioxane was added and the mixture was diluted to the mark with de-ionized

water. The absorbance was measured at 488 nm against a reagent blank. The mercury content of sample was found after preparation of calibration graph (Jamaluddin *et al.,* 2003).

Arsenic- Standard arsenic (III) stock solution 1000 µg ml-1 was prepared by dissolving 0.1732 g of $NaAsO_2$ in 100 ml of water. Working standard solution was prepared by dilution of stock solution; 0.4 M hydrochloric acid, 2% potassium iodate, and 2 M sodium acetate were used. A 0.05% solution of variamine blue was prepared by dissolving 0.05 g of variamine blue in 25 ml ethanol and making up to 100 ml with distilled water, the solution was stored in amber bottle. An aliquot of sample solution containing 0.2-14 µg ml-1 of arsenic (III) was to 10 ml test tubes, then 1 ml of 2% potassium iodate and 1 ml of 0.4 M hydrochloric acid were added and the resultant mixture was shaken properly using cyclomix machine. To this 1 ml 0.05% variamine blue and 2 ml of 2 M sodium acetate solution was added. The solution was kept for 5 minutes and the volume was made to 10 ml with distilled water. The absorbance was measured at 556 nm against the reagent blank (Narayan, 2006).

Table 2. Qualitative detection of heavy metals *

(10 ml of the test solution was concentrated by evaporating on water bath)

Lead	Mercury
1. Ts (test solution) + dilHCl – white ppt 2. Ts + NH_3 solution – white ppt 3. Ts + NaOH – white ppt 4. Ts + dil H_2SO_4 – white ppt 5. Ts + K_2CrO_4soln – yellow ppt 6. Ts + KI solution – yellow ppt 7. Ts + Na-sulphite – white ppt 8. Ts + Na_2Co_3 – white ppt	1. Ts + dilHCl – white ppt 2. Ts + NH_3 solution – black ppt 3. Ts + NaOH – black ppt may turn yellow. 4. Ts + K_2CrO_4 – red crystalline ppt 5. Ts + KI – green/ yellow ppt turn red 6. Ts + Na_2CO_3 – yellow / reddish ppt 7. Ts + Na_2HPO_4 – white ppt 8. Ts + crystals of ammonium thiocynate + pinch of Co-acetate – blue color.
Copper	**Arsenic**
1. 1Ts + NH_3soln – blue ppt 2. Ts + NaOH – blue ppt 3. Ts + KI – brown / yellow ppt 4. Ts + ammonium thiocynate – yellow / brown / black ppt	1. Ts + $AgNO_3$ – yellow ppt 2. Ts + $CuSO_4$ – green ppt 3. Ts + HNO_3 (boil mixture) + NH_4- molybdate – yellow ppt
Cadmium	**Zinc**
1. Ts + NH_3soln – white ppt dissolves in excess of reagent 2. Ts + NaOH – white ppt (insoluble) 3. Ts + HCL – brown ppt	1. Ts + NaOH – white gelatinous ppt 2. Ts + NH_3 – white ppt 3. Ts + Na_2HPO_4 – white gelatinous ppt 4. Ts + NH_4-sulphide – white ppt.

Ts = Test solution; ppt = precipitate

* *Vogel's, Quantitative Chemical Analysis- J. Mendham, R.C. Denny, J. D. Barnes, M.J.K. Thoma*

3. RESULTS AND DISCUSSION

A. The field used for sewage farming was contaminated by various heavy metals to some extent. This was due to the fact that the land is used for cultivation since 1975. Though the metal concentration were within the limits given by Indian safety thresholds (Table 3-4), but the soil concentrations of Cu exceeded the recommended safety thresholds given by Europe and USA and Canada (Vazhacharickal *et al.,* 2013).

B. The results show that the soil between Lower parel (Lp) and Mahim (Mh) is more polluted by Cu on the western railway line and also the same but little less near Andheri (Ad) to Borivali (Bo). Similarly on the central line also Cu is the main pollutant in soil from Curry road (Cr) to Kurla(ku) station and also near Thane (Th) station. On western line, Mahim (Mh) to Ville parle (Vp) and on central line, Sion (Sn) to Ghatkopar (Gk) show high concentration of zinc. This may be due to the fact that this area was clustered with many mills and small industries

and shops of commerce and industrial peripheral manufacturing units and other supplies. Not only Cu but these areas have more concentration of all other heavy metals studied than other areas.

C. It is also clear that the areas which are densely populated by human settlements and industries are more polluted by these metals than the areas where population density is less (Sharma *et al.,* 2008).

D. The soil being less contaminated than expected is also due to the fact that the effluent coming from industrial units are finally released in the sea and is then carried away by the waves (Zindge and Govindan, 2000).

E. The majority of crops grown are green amaranth, radish and spinach and these crops absorb more heavy metals. They store an appreciable amount of Zn, Pb, Cu and Cd. The crops are cultivated in the railway fields all year round and therefore may be in a constant process of extraction of these metals (Arora *et al.,* 2008; Intawongse and Dean, 2006).

F. Still it cannot be negated that a number of soil factors and especially pH plays an important role in making these metals available to plant (Zeng Fanrong *et al.,* 2011).

G. The genetic makeup of plant and the metabolic rate inside, growth rate of plant and the type of storage tissue also has a major role in deciding the absorptive capacity of the plants to such metals. This can lead to removal of some amount of theses metals from soil (Rascio *et al.,* 2011).

H. The presence of heavy metals in soil means that there is presence of these in the sewage water in more amount and they travel to edible plant tissues and may thus affect consumer health.These heavy metals come from factories and other commercial set ups near the sewage supply and these reflect lacking enforcement of existing norms and regulations. However the atmospheric contribution and deposition of heavy metals should also be considered.

I. The sewage water also contains some coliform bacteria which indicates release of animal or human excreta or both in sewage supply channel. Open defecation is commonly seen along railway tracks in Mumbai as there are many slums beside these tracks which lack basic amenities like toilets.

J. The pathogenic microorganisms can stick to green leafy vegetables and may cause diarrhea if the latter are consumed fresh. In India, mostly all the vegetables are cooked and eaten instead of consuming them raw. This practice destroys the pathogenic microorganisms present on the surface of vegetables.

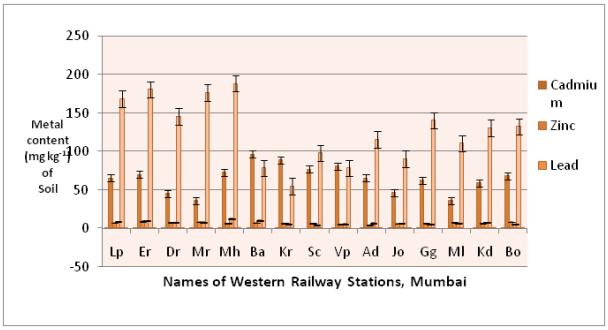

Fig. 1.*Distribution of heavy metals in the soil along Western line railway tracks in Mumbai.*

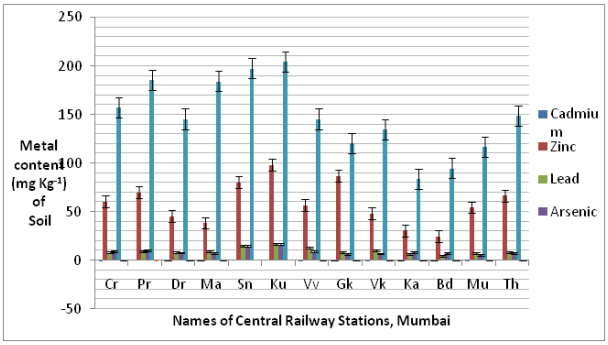

Fig. 1. *Distribution of heavy metals in the soil along central line railwaytracks in Mumbai.*

K. The farmers also use fertilizers and insecticides in order to maximize yield and also to shorten growing periods by providing optimal nutrient availability. These additional fertilizers and the high nutrient content in sewage water will likely lead to a surplus of available nutrients and possibly ground water pollution. They also use diesel operated pumps for crops growing after monsoon season.

L. The vegetable crops are delivered to local markets and so farmers save on transportation and storage cost. In this the consumer is also benefited and additional jobs are created for street vendors.

Table 3. ***Total Cadmium (Cd), Zinc (Zn), Lead (Pb), Arsenic (Ar), Copper (Cu), and Mercury (Hg) concentrations (mg kg^{-1}) in the surface soil (0-15 cm) of vegetation patches beside Western line railway tracks in Mumbai.***

Data	Cd	Zn	Pb	Ar	Cu	Hg
Mean	0.390667	64.61467	7.101333	7.484667	126.0007	0.132
SD	0.25035	17.9185	1.2409	2.18938	41.2536	0.14967
Min	0	35.7	4.24	4.44	5	0
Max	0.86	96.4	9.2	12.65	188.45	0.46
Threshold India*	3-6	300	250-500	2-50	135-270	na

* Awasthi (2007)

Table 4. ***Total Cadmium (Cd), Zinc (Zn), Lead (Pb), Arsenic (Ar), Copper (Cu), and Mercury (Hg) concentrations (mg kg^{-1}) in the surface soil (0-15 cm) of vegetation patches beside Central line railway tracks in Mumbai.***

Data	Cd	Zn	Pb	Ar	Cu	Hg
Mean	0.461538	58.55308	9.573077	8.962308	147.6192	0.195385
SD	0.26692	21.6859	3.31972	3.15918	38.0662	0.189
Min	0.2	24.66	4.8	5.84	83.5	0
Max	1.1	98	16.75	16.42	204.27	0.56

4. CONCLUSION

Sewage farming beside railway tracks in Mumbai provide a good source of income to the railways. It offers protection of highly priced land from encroachers and illegal establishments. It also creates employment opportunity and self sustainability to poor farmers, laborers, and benefits consumers. It reduces the some burden of sewage treatment plants. It enables the farmers to grow crops without the use of much fertilizers and manures. It also contributes to greenery and aesthetics and a good landscape for an observer. In order to strengthen the quality of crops the sewage water should be first treated to remove harmful chemicals and metals and then supplied to such fields. Regulations by government for factories, industries, commercial setups, shops and other settlements beside railway tracks should be strictly enforced and certification schemes should be implemented.

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DECIPHERING THE BOTANICALS IN THE 'IRULAPAMBUKADI CHOORNAM' AN ANTIDOTE AGAINST SNAKE BITE

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ABSTRACT

To collect first-hand information about 'Irula Pambukadi Choornam' ('IPC') and its botanicals an antidote against snake bite. Ethnobotanical survey was conducted in different Irula settlements of Tamil Nadu, using a questionnaire. This study revealed a total of 10 antidote plant belongs to 9 genera and 9 families.The present investigation was aimed at conserving largely herbal drug knowledge and availing to the scientific world the plant therapies used as anti-venom in the society.

Keywords: Antidote, Ethnobotany, Irula Pambukadi Choornam.

1. INTRODUCTION

Venomous snake bites are well known medical emergencies in many parts of the world, exclusively in rural areas where agricultural workers and children are most affected. The incidence of snake bite mortality is particularly high in South East Asia (David, 2010). In India 35,000-50,000 deaths are reported due to snake bite each year (Dhanajaya, 2011).

Nature has provided a comprehensive stock dynasty of therapies to resolving ailments of mankind. Medicinal plants have been used for centuries as remedies for poisonous bites because they contain chemical components of therapeutic value. Traditional healing system plays anvital role in maintaining the physical and psychological well-being of the vast majority in many parts of the world especially in South Asian countries. Nearly 80% of people in developing countries depend on traditional medicines for primary healthcare, most of which are derived from the plants (Kaleel Basha and Sudharsanam, 2012).

Herbal medicine has been widely practiced throughout the world since ancient times. These medicines are safe and environmentally friendly. Tribes in general and South Indian tribes in particular are blessed with rich biological diversity of plants and a high degree of traditional knowledge about medicinal plants and their uses for various ailments of human being (Abu-Rabia, 2005).

The village folk, especially the tribal people are still using the natural resources accessible in their surrounds to treat variousillnesses and other ailments. Though they trust in tantra and mantra in incident of snake bite, they are using both mantra and management of plant drugs (Pradap *et al.,* 2010). For the treatment of snake bite they believe in tantra, mantra and herbal medicine is also administered.

The tribe is extremelyearmarked and so the collection of ethnobotanical information is very difficult task. In Tamil Nadu, Irulas are a group of tribal community belongs to the Negrito race which is one of the main primitive vulnerable ethnic groups in India (Deepa *et al.,* 2002). Even today Irula local communities practice herbal medicine to cure a number of diseases particularly snake bite. Remedies are mostly prepared with native wild species which contain at least one bioactive compound (Felix *et al.,* 2004).

The indigenous traditional knowledge of Irula tribe, which has been transmitted orally for centuries, is fast disappearing due to the advent of modern technology and transformation of traditional culture (Ganesan *et al.,* 2004). Hence the present investigation was carried out to document the botanicals present in the 'IPC' an antidote against snakebite.

2. METHODOLOGY

From 2014-2015, Irula tribal villages were visited in different districts of Tamil Nadu. The herbal practitioners (Vaidyars) in those areas were interviewed and information on medicinal plants was collected (Fig.1 L). Thirty informants were interviewed to get authentic antidote composition, dosage of the drug, mode of administration and diet

restriction during treatment period. The result of this study reveals the botanical name, family, local name and part used of 10 medicinal plants (Table 1) used in the preparation of 'IPC' which is used by Irula tribe as an effective antidote against snake bite.

3. RESULTS

The 'IPC'is prepared out of 10 medicinal plants (Fig. 1 A-J) which are shade dried and grind well in a mortar and pestle. The fine powder thus obtained is stored in air tight glass containers for the future use. The dosage of 'IPC'(Fig.1 K) for an adult individual is 20 grams and 10 grams for children. It is administered orally as dry powder in the morning and evening in empty stomach for 3 days. In the first day of the treatment, the patient will not be permissible to sleep. There is strict diet restriction throughout the treatment period, like salt should not be added in the food.

Table 1. List of medicinal plant in the 'IrulaPambukadi Choornam' used to treat snake bite.

S.No.	Botanical name	Family	Local name	Part used
1.	*Acalyphaindica*L.	Euphorbiaceae	Kuppaimeni	Whole plant
2.	*Alangiumsalvifolium*(L.f)	Alangiaceae	Alingil	Bark
3.	*Andrographisalata*Nees.	Acanthaceae	Periyanangai	Whole plant
4.	*Andrographispaniculata*Nees.	Acanthaceae	Siriyanangai	Whole plant
5.	*Aristolochiabracteolata* Lam.	Aristolochiaceae	Aadutheandapalai	Whole plant
6.	*Azadirachtaindica*(L.)Adr.Juss.	Meliaceae	Vembu	Bark
7.	*Corollocarpusepigaeus*Rotter.	Cucurbitaceae	Agasagarudan	Tuber
8.	*Enicostemmaaxillare*(Lam.) A.Raynal,	Gentianaceace	Vellaragu	Whole plant
9.	*Leucasaspera*Spreng.	Lamiaceae	Thumbai	Whole plant
10.	*Strychnosnux-vomica* Linn.	Loganiaceae	Yetti	Bark

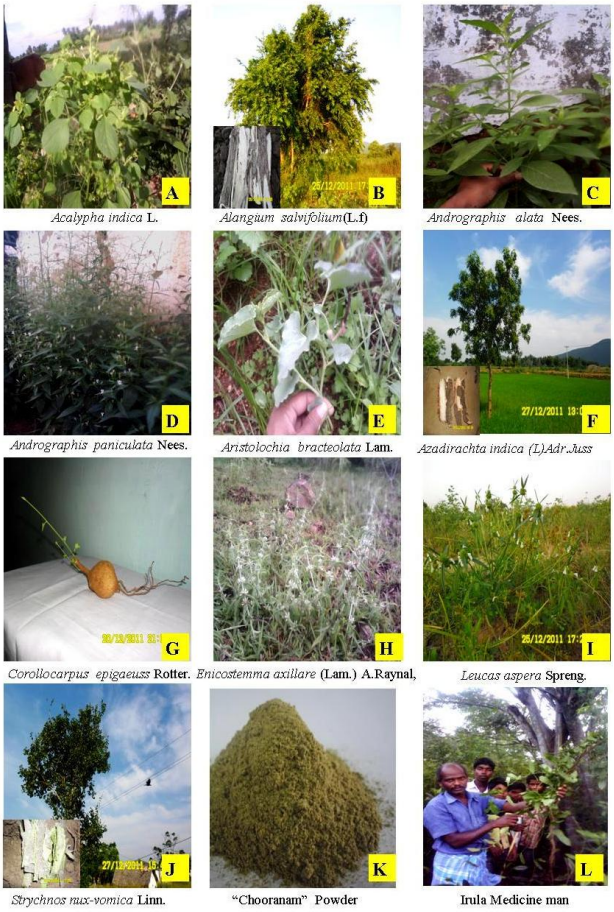

Figure 1. Medicinal Plants and Chooranam of Irulas against snake bite

The 10 medicinal plants belong to nine genera in nine families of which four are herbs, three trees, two shrubs and one climber. Regarding the usage of plant parts, whole plant is used in six cases, bark of three plants and tuber of one plant (Table 1).

4. DISCUSSION

The 'IPC' used for snake bite treatment by Irulas possess some chemical compounds which inhibit the toxicity of snake venom. The credibility of this ethnobotanical information is supported by the experimental findings of six plants for their snake venom inhibiting property. The methanol extract of *Acalypha indica* leaves showed Russell's viper venom neutralizing property in rat model (Shirwaikar *et al.,* 2004). Similarly the alcoholic extract of *Andrographis paniculata* inhibits cobra venom in albino mice (Premendran *et al.,* 2011). Phospholipases are important component in snake venom. The aristolochic acid present in *Aristolochia bracteolate* (Wagner and Praksch, 1985) and *Andrographis alata* (Walter Martz, 1992) possess phospholipase inhibitory properties. Cobra and Russell's viper venom phospholipase A2 inhibited by the methanolic leaf extract of *Azadirachta indica* (Mukherjee *et al.,* 2008). In an *in vivo* study with albino mice, crude root extract of *Corollocarpus epigaeuss* showed venom neutralizing activity (Chandrakala *et al.,* 2013).

5. CONCLUSION

Even though we have many drugs in antibiotics, anticancer and antidiabetic category, so far not even a single drug has been discovered to treat snake bite. The only therapy available for snake bite is the polyvalent anti-snake venom. The contributions of various traditional systems of medicine in modern drug discovery cannot be ignored. In this context further elaborative clinical work is necessary for the elucidation of active principles from these plants for drug discovery against snake bite.

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ASSESSMENT OF BACTERIA IN AQUAPONICS BY CULTURE DEPENDENT TECHNIQUES

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ABSTRACT

Aquaponics is an intensive sustainable food production system that combines aquaculture and hydroponics, in which fish and plants grow together symbiotically. In an aquaponic unit, the effluent rich nutrients derived from nitrogenous waste excreted from fish, fish feed and decomposing organic matter, fertilizes hydroponic beds providing essential nutrients for plant growth. Simplified raft aquaponic system vary greatly in design and construction, but perform all key functions of plant and fish production, removal of suspended solids and bacterial nitrification. All life forms require nitrogen as an integral part of proteins and nucleic acids, therefore all living organisms are involved in the nitrogen cycle. This process is primarily accomplished by two groups of autotrophic nitrifying bacteria that can build organic molecules and utilize CO2 as the carbon source for biosynthesis and oxidation of nitrogen compounds as the energy source. A broad range of major parameters and factors affecting bacterial growth has been studied in this paper which are essential for nitrification, that include healthy biofilter with appropriate water conditions like, water temperature, pH, dissolved oxygen (DO), total nitrogen concentrations. Characterization and identification of bacterial populations in an aquaponics system has been carried out by cultivation-dependant techniques and traditional methods of analyzing microbial communities using standard light microscopy.

Keywords: Raft Aquaponic system, Nitrification, biofilteration, biofilm, mineralization.

1. INTRODUCTION

The word 'aquaponics' is derived from a combination of 'aquaculture' (fish farming) and 'hydroponics'(growing plants without soil), refers to a bio-integrated system linking recirculating aquaculture with hydroponic production of plants. A brief history of aquaponics and its evolution has been provided Aquaponics is a new paradigm of adopting advanced technologies to practice and increase agricultural productivity (Jones, 2002). Smart farming entails the application of new technique of raising fish and growing vegetables in one unit of infrastructure system there by wisely conserving earth resources (Tangonan, 2012). Aquaponics is relatively a new concept of producing nutritious food which integrates two proven cultures, with a reliable production system which uses minimum water supply in non-soil media under unproductive space (Connolly, 2010). Water replacement comes from negligible losses due to plant evapo-transpiration and atmospheric evaporation (Lennard and Leonard, 2006). The selection of plant species are related to the stocking density of fish tanks and subsequent nutrient concentration of aquacultural effluent (Sace and Fitzsimmons, 2013), Common greens (Celery, Lettuce, Basil) do well in aquaponic systems, plants yielding fruit (tomatoes, bell peppers and cucumbers, beans, peas, and squash) have a higher nutritional demand, which perform better in a higher stocked, well established aquaponic system (Rakocy, 1999a). Freshwater systems rely on three major elements like freshwater aquatic animals, plants and nitrifying bacteria. Aquaponics system consist of a fish tank with one or more grow beds for vegetable production. Biological water filtration removes nutrients that are generated from the feces of fish, decomposing feed, which act as liquid fertilizer for plants and the hydroponic beds function as biofilters. Bacteria in the gravel have a critical role in the cycling of nutrients, without these organisms, the system would stop functioning (Rakocy, 1999a; Diver, 2000). Nitrification is a key microbial process in N-removal and is carried out by the chemolithoautotrophic nitrifying bacteria in aquaponic systems (Stief *et al.,* 2009; Beaulieu *et al.,* 2011). The overall functioning of an aquaponic system depends upon ammonia-oxidising bacteria (AOB) and nitrite-oxidising bacteria (NOB). In the aquaponics system during the process of fish respiration, oxygen and carbon dioxide are exchange d and ammonia from the fish excrete is converted into nitrite and nitrate by bacteria. which in turn is used by the plant for its growth. The nitrifying bacteria convert the waste excreted by the fish which contains carbon dioxide and nitrogenous compounds (John and Fred, 2012). Carbon dioxide

return to the water via fish gills are then used as the primary carbon source by the photoautotrophs present in the system (Mills, 1987). The two step process of nitrification occurs as follows: 1) AOB bacteria convert ammonia (NH_3) into nitrite (NO_2-) 2) NOB bacteria then convert nitrite (NO_2-) into nitrate (NO_3-) (Noophan *et al.,* 2009). Therefore, a healthy bacterial colony is essential for the functioning of aquaponic system. Nitrifying bacteria usually show low maximum growth rates, low substrate affinities thus have long generation times due to low energy yield from their oxidation reactions, have evolved to become extremely efficient in converting ammonia and nitrite.

2. MATERIALS AND METHODS

An experiment was conducted to know about the nitrification process in aquaponic system. A study was conducted at indoor Coonoor, Nilgiris, Tamilnadu, India. The system was operated with fishes and plants (starting from November 2013) and water from river-Pykara was the source experimented with for a period of six months. Glass microscope slides were placed in two locations of the aquaponic system as a substrate for biofilm development, where the growth of micro-organisms occurs. Three slides for each of the triplicate systems were attached to a plastic tray utilizing aquarium grade silicon were placed at the bottom of the tank containing the common carp (*Cyprinus carpio* L.) has been setup. This gave a total of 36 slides from the entire system. Three slides were removed weekly from every set of systems arranged. Fish carp juveniles (15 no.) weighing an average of 10.0 g each, with 9cm in length were acclimated and transferred to a 40 L polystyrene tank. Standard feed of 2% of its body weight was fed twice daily. An aerator was installed in the unit. Holes are cut in the sheet to accommodate small plastics pots. The bottom and sides of the pots are perforated sufficiently to permit easy movement of the plant roots into the nutrient water. Five plant pots are inserted into the holes of the Styrofoam sheets. The pots are filled to a height one inch below the top with small size gravel, the bottom of the pots remains immersed in the water which acts as the media for the hydroponics component. Leafy green vegetables of three weeks growth purchased from a local nursery are then planted in the pots on the Styrofoam raft. Stocking density was measured in units of fish biomass per volume of water^3. The stocking density, fish health, fish feed are important aspects for the functioning of the system, where aeration and water exchange renew dissolved oxygen supplies, which remove waste and increase the growth of bacteria in the system.

System Components-Aquaponic unit (aquaculture part) for raising fishes are rectangular water tank (size-45cm breadthx33cm length x27cm height) with volume of 40 litres capacity, aquarium air pump 220-240 voltage with power of 5 watts,output-6 litre/minute, frequency-100 Hz and (hydroponics part) for growing plants. Floating or raft hydroponic sub system is ideal for the cultivation of leafy and other types of vegetables Plants are grown in hydroponic component that utilizes the nutrient rich water. Depending on the sophistication and cost of the Aquaponics system, the units for solids removal, biofiltration, or the hydroponics subsystem may be combined into single unit The above system operation was started with the introduction of fishes into the aquaculture tank and placing the raft on top of the aquaculture tank. Closed-cell polystyrene sheets support vegetables at the water surface with roots suspended in the culture water .The fishes were fed without planting anything in the pots for a period of two weeks to allow the microorganisms to grow in the media bed inside the pots. Temperature of the water in the tank is monitored using a Jumbo Thermometer. Weekly observations were made of the pH, DO, Nitrite, Nitrate and total ammonia nitrogen (TAN) of the water using standard kits. A number of hydroponic systems have been used in aquaponics

Biofilteration-Effectiveness of biological filteration increases the efficiency of the nitrogen cycle. Biological filters in aquaponics create an environment to grow microorganism. Nitrification in the bacterial film of the biofilter is affected by a variety of parameters such as temperature, pH, DO concentration, alkalinity, salinity, substrate and organic matter (Satoh *et al.,* 2000; Chen *et al.,* 2006). A major concern in aquaponics is, biofilteration were the conversion of metabolic waste product excreted through the gills of fish are broken down into smaller particles, converting the organic macromolecules into nutrients. The media bed with solid particles forms a complex matrix which is the primary site for bacterial growth. Bacteria form colonies in the interstitial spaces of the media bed formed of gravel which varying in size to form a thin film known as biofilm. Thus the media bed effectively acts as biofilter. Due to the build-up of biofilm over time, larger bacterial colonies appear. This biofilter has the potential to continue filteration of the solid fish waste and other particles in the water without clogging for extended periods of time. The function of the system depends upon the

stocking density of fish and proper maintenance of the system (Rakocy *et al.,* 2006).

Biofilm-Biofilms are biological structures that coat the surfaces of submerged substrates and are endemic in aquaculture systems. Since nitrifying bacteria are photosensitive, sunlight can cause considerable harm to the biofilter. Media beds along with biofilm formation around the biofilter, prevents direct sunlight and thus protects bacteria. Bacterial Colonizing occurs in the biofilter which is the preferred settlement of the bacteria with dark environment. The nitrifiers creates a slimy bio-film, as light brown or beige matrix on the biofilter, and have a distinctive odour, but does not smell particularly foul which could indicate other micro-organisms. Good biofilms smell earthy, if otherwise, it is an indication of imbalance in the system. These biofilms protect themselves from desiccation and other potential threats. The overall health of the bacteria at any given time need to be maintained by monitoring all parameters for proper functioning of the aquaponic system. The simple method to monitor the bacterial function is by testing levels of ammonia, nitrite and nitrate which provides the information on the health of the bacterial colony. Ammonia and nitrite should always be 0–1 mg/litre in a functioning and balanced aquaponic unit. Imbalance occurs in the system due to too many fishes, excess fish feed and improper filteration. By reducing fish number, fish feeding regime and by increasing the size of the biofilter this problem can be rectified. Even if the system size is balanced, bacterial activity may be slow during winter seasons. Therefore each parameter should be monitored for the effective functioning of the system.

Mineralization-The dissolved nutrients comprises of fish waste from gill excretion, urine, faeces and feed remains that are assimilated by the plants. These bacteria feed on any form of organic material, such as solid fish waste, uneaten fish food, dying plant parts and dead bacteria. Heterotrophic bacteria require similar growing conditions as nitrifying bacteria especially in high levels of DO. They colonize all components of the unit, especially concentrated in the area of solid waste accumulates and utilize dissolved organic carbon as its food source. Most of the fish retain only 30–40 percent of the food they eat, remaining 60–70 percent are released as waste. Of this, 50–70 percent is dissolved waste released as ammonia, and the remaining are organic mixture of proteins, carbohydrates, fats, vitamins and minerals. The heterotrophic bacteria metabolize these solid wastes and release inorganic nutrients into the water, called mineralization which are essential micronutrients, and the microorganisms that decompose solid wastes are antagonistic to root pathogens thus maintain healthy root growth for the plant in the aquaponic system. Chemotrophic bacteria such as Nitrosomonos sp. utilize ammonia as their food source and produce nitrite as end product, Nitrospira grow as long as food source is available, utilize nitrite as a food source and liberates nitrates as waste product. Heterotrophic bacteria grow much faster than the nitrifying bacteria, reproducing in hours rather than days colonize all components of the unit, especially concentrated at the bottom of the tank were solid waste accumulates. Second step of nitrification ($NO2 \rightarrow NO3$), is very sensitive to traces of sulphides are present in sediments and sludges (Joye *et al.,* 1995). Mineralization is important because it releases several micronutrients which favors plant growth in aquaponic system.

Water quality parameters-According to methods described in (APHA, 2005; Hach company, 2003) all the water quality parameters were analysed (Table1). Temperature, pH and DO are the most important factors to be balanced for fish, plants and microbes and these details were recorded using Hach Model HQ40D with digital pH sensor. Other parameters such as alkalinity, ammonia, nitrite and nitrate were analyzed using the standard methods (Eaton and Franson, 2005). Nitrifying bacteria are extremely susceptible to high concentrations of ammonia, nitrous acid, low DO and pH outside the optimal range (7.5–8.6) (Masser *et al.,* 2009; Villaverde *et al.,* 2000; Ling and Chen, 2005). The optimal water temperature range for nitrifying bacteria is 17–34°C. This encourages growth and productivity and tend to decrease during colder periods. Therefore nitrite should be more carefully checked to avoid harmful accumulations in the system. The target pH for aquaponics is 6–7, for the organisms within this ecosystem. But bacteria work better at higher pH, and function effectively through a water pH range of 6–8.5.while the optimum pH for nitrification was 7.5 to 8.0 Nitrifying bacteria need adequate levels of DO to grow healthy and maintain high levels of productivity (Kim *et al.,* 2007). As the oxygen levels decreases beyond 1mg/L, dissolved oxygen becomes the limiting factor for nitrification (Mao *et al.,* 2008). Nitrification is a (redox) reaction, where the bacteria derive the energy to live when oxygen is combined with nitrogen. Optimum levels of DO are 4–8 mg/litre, which is the required level for fish and plants. Nitrification does not occur if DO concentration drops below 2 mg/litre. Installation of aerators ensures adequate biofiltration in media

beds of aquaponic systems. For higher C/N ratios, the heterotrophic bacteria compete with nitrifiers for available oxygen and space in the biofilters (Michaud *et al.,* 2006). Therefore nitrification necessitates a low C/N ratio.

Culture Methods-Cultivation-dependant, traditional methods of analyzing microbial communities in wastewater treatment systems were carried out as plate count or most-probable number counting to determine the abundance of filamentous bacteria, using Gram and Neisser-staining methods (Jenkins *et al.,* 2004). Various mixed bacterial colonies were grown in nutrient agar medium till a pure culture was obtained. It was then isolated and identified using gram staining, motility and biochemical characters.

Table 1. Physicochemical parameters.

PARAMETERS	DEC	JAN	FEB	MAR	APR	MAY
Temp	16	19	20	22	24	26
pH	7.59	8.40	7.07	7.2	7.5	7.85
DO	7.9	7.3	6.9	6.6	6.4	6.1
Nitrite	0	0.1	0.03	0.02	0.01	0.01
Nitrate	1.0	1.0	4.0	5.2	6.3	6.6
TAN	1.38	1.66	1.78	2.05	2.24	2.36
Total Alkalinity	8.0	14	18	32	48	67
Total hardness	12	20	24	31	42	61
Calcium Ca mg/L	14	26	37	50	69	78
Magnesium	11	23	32	45	57	69
Iron mg/L	1.48	0.17	0.74	0.98	1.21	1.38
Manganese	0.16	0.35	0.42	0.34	0.31	0.29
Free Ammonia	1.38	1.66	1.78	2.85	5.64	9.49
Chloride	6.0	11	21	38	46	69
Fluoride	0.3	0.3	0.3	0.3	0.3	0.3
Sulphate	2.0	6.0	10	16	19	21
Phosphate	0.16	0.94	3.95	8.52	12.1	17.9

Table 2. Method of culture and enumeration of bacterial species.

Procedures	Explanation
Collection of biofilm	Slides were scraped free of biofilm by a scalpel. The biofilm was diluted in a known volume of deionised water and homogenised using a magnetic stirrer for 15 minutes. The homegenised diluted biofilm was used for the culture and isolation of bacteria.
Ten-fold dilution of sample	Four small beakers were filled, each with 9ml of deionised water. 1ml of the sample was added to the first beaker and mixed thoroughly. 1ml of this solution was added to the next beaker and so on. This gave four beakers with the dilution factors of x10; x100; x1000; x10,000
Inoculation of agar for bacterial culture	Bacteria were cultured on the general medium, tryptic soy agar (TSA) (Buller, 2004; King *et al.,* 2004; Whitman, 2004) using the streaking method, as described by (Whitman, 2004) for colony forming unit (CFU) counts and isolation of pure colonies. Plates for each dilution were inoculated in triplicate
Incubation of plates	Agar plates were incubated at 25°C for 48 hours (Whitman, 2004). They were checked at 24 hours for bacterial growth.
Determination of colony forming units (CFU)	A darkfield colony counter was employed for enumeration of CFU using the plates with TSA. Initial and secondary dilutions were multiplied to ascertain the conversion factor.
Isolation of bacterial colonies	Bacterial species were sorted according to morphological features, Grams stain (and 3% KOH test), catalase and oxidase tests 'Bergey's Manual of Determinative Bacteriology' (Buller, 2004; Bergey and Holt, 1994).

3. RESULTS AND DISCUSSION

The purpose of this study was to make an assessment of bacteria in aquaponics by culture-dependant techniques using traditional methods and to create a congenial atmosphere for the colony development of bacteria which helps the growth of plants. The following parameters of water temperature, pH, dissolved oxygen, nitrites, nitrates, Total ammonia nitrogen (TAN) were analyzed to attain a desirable environment for bacteria in the systems. Fish and bacteria prefer a pH of 7.0-9.0 and most plants grow within 5.8-6.8 desirably. A pH higher than 8 can prevent plants to absorb the nutrients which results in deficiency (Anderson *et al.,* 1989) and beneficial to fish and bacteria. A desirable pH ranging from 6.0-7.5 is a major limiting factor in aquaponics. Optimal pH for aqua cultural crops and bacteria are usually productive. In the entire studied period, water temperature and DO were maintained between 16-26°C and 6.1-7.9 ppm in all the systems (Mishra and Yadav, 1978). Referred dissolved oxygen as a major component in biochemical changes and effects metabolic activities of organisms. In the present experiment, there was variation in the level of pH (7.0-8.4) which was favorable throughout the experiment.

Table 3. Results of Bacterial cultures.

The given bacterial cultures were identified as

Sl.No.	ORGANISMS	METHOD	RESULT
1	P	BERGY'S MANUAL OF DETERMINATIVE BACTERIOLOGY	Serratia marcescens
2	W2	BERGY'S MANUAL OF DETERMINATIVE BACTERIOLOGY	Bacillus cereus
3	Y	BERGY'S MANUAL OF DETERMINATIVE BACTERIOLOGY	Bacillus subtilis
4	R	BERGY'S MANUAL OF DETERMINATIVE BACTERIOLOGY	Bacillus megaterium
5	W1	BERGY'S MANUAL OF DETERMINATIVE BACTERIOLOGY	Enterococcus faecalis
6	O	BERGY'S MANUAL OF DETERMINATIVE BACTERIOLOGY	Micrococcus luteus

Table 4. Morphology and Biochemical parameters.

ORGANISM	P	W2	Y	R	W1	O
Colony Morphology In nutrient agar	Round, Small, flat, red, Semi transparent, hard and adhere to the agar	Large irregular, flat opaque creamy white centre with yellow margin.	Medium, creamy colonies with irregular margin, flat colonies, hard and adhere to the agar	Large,rhizoidal, flat opaque light rosy-white centre with yellowish white margin, hard and adhere to the agar	White, large, regular, opaque, flat colonies.	Large, round,creamy yellow, raised, convex, opaque colonies
Growth	Moderate to good	Moderate to good	Moderate to good	Moderate to good	Moderate to good	Moderate to good
Microscopy						
Gram stain	-ve Bacilli	+ve Bacilli in chain	+ve Bacilli	+ve Bacilli	+ve Cocci in pairs and chains	+ve Large cocci in pair and tetrad
Motility	motile	motile	motile	motile	Non motile	Non motile
Biochemical characteristics						
Indole test	-	-	-	-	-	-
Methyl Red (MR)	-	-	-	+	-	-
VP	+	+	-	-	-	-
Citrate	+	+	+	+	+	+
Urease	-	-	-	-	-	-
Glucose	+	+	+	+	+	+
Lactose	-	-	-	-	+	-
Sucrose	+	+	+	-	+	-
Maltose	+	+	-	-	+	+
H_2S	-	-	-	-	-	-
Catalase	+	+	+	+	-	+
Oxidase	-	-	-	+	-	+

Fig. 1. Colony of *Serratia marcescens* and *Bacillus cereus.*

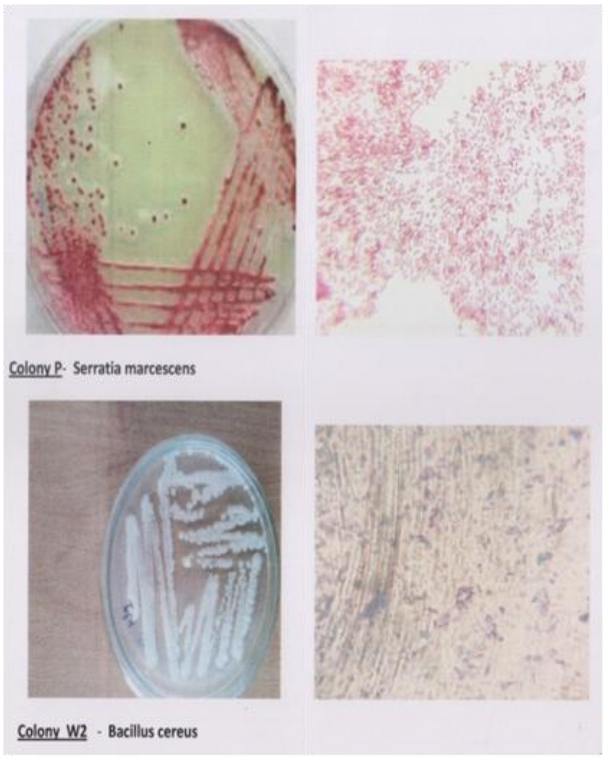
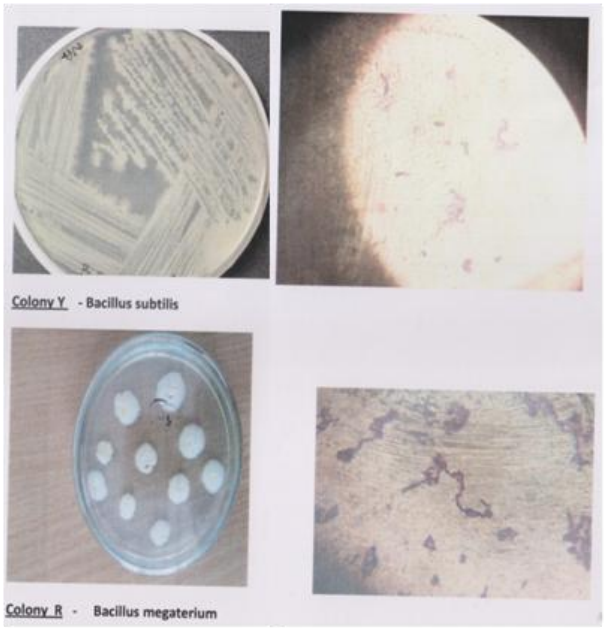


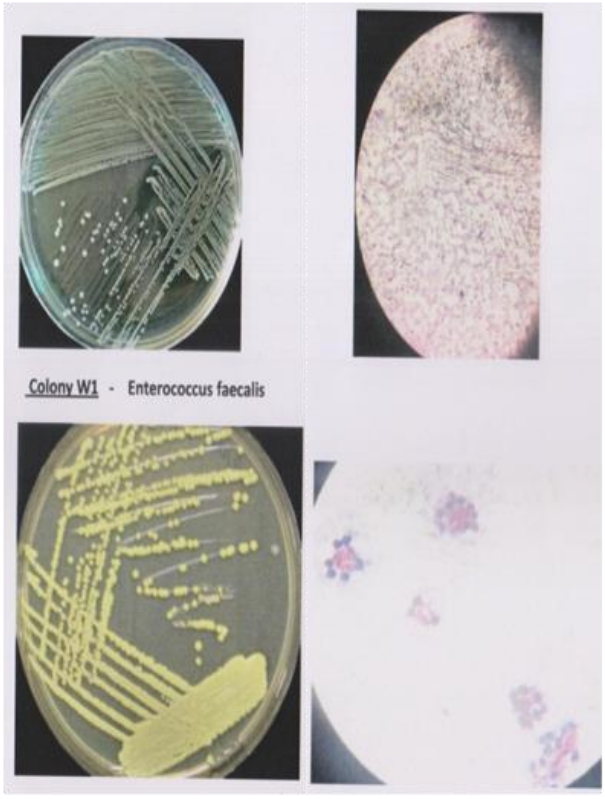
Fig. 2. Colony of *Bacillus subtilis* and *Bacillus megaterium.*



Reduction in pH was due to the production of CO2 in water as a result of respiration of fish, bacteria and plant roots in aquaponics system. Spontaneous bacterial colonization occurs in the

biofilter following the introduction of fish into the system. After one month of time a large drop in NH4 content of the water was observed this refers to the multiplication phase carried out by bacterial population to oxidize larger quantity of NH4 into NO2. Around third month of the experiment nitrification occurred in a balanced way so ammonia and nitrates remained at low levels which was similar to the report (Petit, 1986). All the three systems remained in equilibrium with stable functioning of NO3 content between 1.0 and 6.6 mg/L. In this study, the nitrification rate of the system was calculated based on the ammonia removal rate. Microbial nitrification of ammonia to nitrite and nitrate is optimized at pH 8.5 and plant nutrient uptake is optimized near pH 6.0 thus pH in aquaponic system is maintained near pH 7.0 (Wortman, 2015).

Fig-3: Colony of *Enterococcus faecalis* and *Micrococcus luteus.*



Oxygen is important in waste management because the bacteria breaking down the organic waste require oxygen (Fred, 2002). Several mass balance models in open system have been proposed from previous studies (Pagand *et al.,* 2000; Papatryphon *et al.,* 2005; Mongirdas and Kusta, 2006), from which total nitrogen and phosphorus discharges into receiving waters can be estimated. Recently, the incorporation of recirculated fish with vegetable production has become a new model (Bakhsh *et al.,* 2007; Endut *et al.,* 2009). During oxidation of NH4+, pH increased from 7.1 to 8.45 under high ammonium loads. Free ammonia is NH3, the toxic form of ammoniacal N which may inhibit the heterotrophic nitrification activity but not the growth.

Heterotrophic nitrification and cellular growth differ according to pH conditions. Highest removal of ammonium and oxygen demand was presented at 7.5 pH. This shows that bacterial growth was preferentially proceeding at high C/N ratios, to maintain safety values of ammonium inside the system, which was earlier reported (Leonard *et al.,* 2000; Ren *et al.,* 2014). Enumeration and culture of bacteria in aquaponics system. Bacterial colonies were sorted according to morphological features (Table 3 and 4) were all represented moderate to good growth. Only *Serratia marcescens* was gram negative stain and the test for motility was recorded with *Enterococcus faecalis* and *Micrococcus luteus. as* non motile species. Biochemical reports suggests indole test, urease and H2S with negative results for all the species studied, were as all the species showed a positive result with citrate and glucose tests.(Fig-1,2 and 3)represents the bacterial colonies isolated from the aquaponic system. These media, on volume basis have low capacity for fixing and storing nutrients (Bunt, 1988) but are more consequently fertilized with high amounts of N. Due to bioconversion of ammonia by nitrifying bacteria into nitrite and to nitrate there is right balance between fish nutrient production and plant uptake. Careful management of ammonium nutrient sources help one to achieve the desired crop nutrient supply and minimize losses of nitrate. In the beginning of the experiment, there were no enough nitrifying bacteria in the system observed which was similar to the report (Yamamoto *et al.,* 2008) with the growth of AOB, the accumulated TAN oxidized to No2-.was attributed to the different growth rate were AOB increased faster than NOB when there was raise in temp above 25°C .Nitrifying bacteria are relatively slow to reproduce and establish colonies, requiring days and sometimes weeks or more which is one of the most important management parameters when establishing a new aquaponic system This reveals that water temperature had significant influence on nitrification. Benefit of aquaponics is that organic fish effluent replaces the need for inorganic commercial chemical fertilizers, providing potential chemical free, nutritious products by minimizing the

need for discharge due to its recirculating nature with the key role by bacteria (Ghaly *et al.,* 2005).

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EXPLORATION OF PLANT SPECIES USED BY THE TRIBAL, KOTAS FOR THEIR MEDICINAL USES IN THE UPPER REACHES OF KOTAGIRI, THE NILGIRIS, WESTERN GHATS

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ABSTRACT

The medicinal plants provide an efficient local aid to health care and disease free life. The present investigation has been under taken in Trichigady, Kotagiri terrace, Nilgiri biosphere during the study period June 2016 to December 2016. In order to study that the traditional uses of these folk medicinal practice day todays life it as resulted providing information of 66 wild plants. Out of the 140 species are comprised in the families like Acanthaceae, Amaranthaceae, Convolvalaceae, Euphorbiaceae, Rutaceae, Solanaceae etc. In this case study, they are used 66 plants in medicinal purpose and 74 plants are used as edible food respectively. So this investigation is held us to understand how indigenous knowledge possess by Kota tribal of study area.

Keywords: Tribal, Kotas, Western Ghats, Kotagiri.

1. INTRODUCTION

The medicinal plants represent not only a valuable part of India's biodiversity but also a source of great knowledge. The WHO has listed 21,000 plants that are used as medicine around the world. India has a rich medicinal plant flora of some 25,000 species (Bhattacharjee, 2001). There are 1532 edible wild food species in India, mostly from Western Ghats and Himalayan region (Kujur, 1989). Only about 2 percent of more than 250,000 species of higher plants have been carefully evaluated for medicinal activity (Deepak Chopra and David Simson, 2000).

The Trichigady village is a part of Kotagiri, Nilgiri Hills,the Western Ghats, Tamil Nadu, India were selected for the present study to obtain the medicinal and edible plants information from Kota tribal village. The study are located at latitudes 10º 45' to 12º 15' N and longitudes 76' to 77' 15°E. The elevation of the study area is 2320m above MSL. The species richness is high in general and many of the species showed variations in their populations which aided the species for better distribution, survival and perpetuation in different microclimatic conditions. In addition to commonly distributed species, many red listed species with various economic uses are also distributed in the existing vegetations (Prasad and Balasubramaniam, 1996; Murugesan, 2005). Further, due to illegal exploitation, it has been determined that many species attained low status of population size (Paulsamy *et al.,* 2008).

Principally, earlier studies in the Nilgiri Biosphere Reserve have dealt with medicinal species and little attention was paid to wild edible plants (Perumal Samy and Ignacimuthu 2000; Rajan *et al*., 2003; Rajasekaran *et al.,* 2005; Udayan *et al.,* 2007; Revathi and Parimelazhagan 2010; Poongodi *et al.,* 2011). Vedavathy (2002) gave an account of the real alternatives of the tribal medicine.

Rajan, *et al.* (2002) discussed the flowering plants uses for remedial purposes by the Kattunayakas of Nilgiris, Tamilnadu. Rajendran, *et al.* (2004) gave a detailed account on medicinal plants and their utilization by villages in Southwestern Ghats, Tamilnadu. Ganesan, *et al.* (2004) reported the ethno medicinal aspects of 45 species of plants used by the Paliyan and Pulayan tribe of lower Palani hills Tamilnadu. Hema, *et al.* (2006) identified a total of 15 taxa and recognized as being used by Kurumba and Paniya of Wyanad district, Kerala.

In recent times, due to inexplicable reasons there has been a rapid decline and deterioration of folk medical practice/traditional knowledge. Therefore, the revival and revitalization of this folk medical system is to be improved on its scientific base. In such cases, the tribal medicine can provide safe, stable, standardized and therapeutically effective drugs not only to the tribal communities but also to the other populations can affordable cost.

2. MATERIALS AND METHODS

Each and every ethnobotanical work has various activities. They are field trip, observations, identification retrieving the medicinal properties and mode of preparation of drug from the plants by Kota tribal.

Trichigudy village is located in a part of Kotagiri, Nilgiri Hills (NBR), the Western Ghats, Tamilnadu. The present investigation was undertaken with a view of studying the uses of plants in study area. Intensive botanical exploration trip were undertaken in and around trichigady during the period of November 2013 - April 2014. In this period per a month 4 trips were done. During this trip we have collected the information about the edible plants and the medicinal plants including their parts uses and aliments were obtained from Kota tribal.

The voucher specimen plants collected were identified with the help of Flora of Presidency of Madras by J.S. Gamble (1936) and Flora of Tamilnadu and Carnatic by K.M. Mathew (1983).

The medicinal plants collected in this way are tabulated. They are documented, both family and genus are arranged according to the alphabetical order. The botanical names followed by author citation and synonyms of the plant species, local name of the plant species also provided. Most of the plants are used as a medicine rest of them served as an edible plants.

3. RESULTS AND DISCUSSION

The study area Trichigady Kota village is located in a part of Kotagiri, Nilgiri Hills [NBR], the Western Ghats, Tamilnadu. About 140 species are collected spreading over – families (Table 1 – 3). They are identified for their medicinal and edible importance with the help of Kota tribal people. The ethnobotanical studies of some tribal area are reported (Rajan and Sethuraman, 1991; Rajesekaran *etal.,* 2005; Yasodharan and Sujana, 2007; Rasingam and Rehel, 2009; Rasingam, 2010; The taxonomic position were identified through relevant literatures.

Table 1. List of medicinal plants used by Kota tribal in study area.

S.No	Scientific name	Family	Parts used	Ailments cured
1	*Acacia leucophloea*(Roxb.) Willd.	Mimosaceae	Bark	Bone Fracture, Cuts and burns
2	*Acalyphafruticosa*Forsskal	Euphorbiaceae	Whole Plant	To Control worms
3	*Achyranthusbidentata*Blumeic	Amaranthaceae	Leaf	To cure skin disorders
4	*Aeglemarmelos*(L.) Corr. Serr.	Rutaceae	Bark	Diarrhea
5	*Alangiumsalvifoliumvar.hexapettalum*Wang	Alangiaceae	Bark	Snake antidote& Paralysis
6	*Albiziaamara*(Roxb.)	Mimosaceae	Leaves ,bark	For hair growth, Cuts and burns
7	*Aloe vera*(L).Burm.f.	Xanthorrhoeaceae	Fruit	Skin disorder
8	*Andrographispaniculata*Vahl	Acanthaceae	Roots	Snake antidote
9	*Andrographisserphilifolia*Vahl.	Acanthaceae	Roots	Snake antidote
10	*Anogeissuslatifolia*Wallich ex Guill. &Perr.	Combretaceae	Bark	Stomach ache
11	*Ageratum conyzoides*Linn.	Asteraceae	Leaf	Wound healer
12	*Argyreiaspeciosa*Burm.f	Convolvulaceae	Roots	Fever and headache
13	*Arisaemaleschenaultii*Blume	Araceae	Roots	Snake antidote
14	*Azadirachtaindica*Adr.Juss.	Meliaceae	Bark	Leaves To Control worms, Mouth Ulcer
15	*Barleriabuxifolia*L.	Acantaceae	Roots	Stomach pain
16	*Bauhinia racemosa*L.	Caesalpiniaceae	Bark	Dysentery
17	*Berberiestinctoria*Lesch.	Berberidaceae	Leaves	Polycystic ovarian syndrome
18	*Calotropisgigantea*(L) R.Br	Asclepiadaceae	Leaves	Foot problems
19	*Canthiumcoromandelicum*(Burm.f.) Alston	Rubiaceae	Bark	Fever
20	*Capparissepiaria*L.	Capparaceae	Leaves	Hip pains, dysentery
21	*Cappariszeylanica*L.	Capparaceae	Leaves	Breathing problems
22	*Cassia occidentalis*L.	Fabaceae	Roots	Swellings over body
23	*Celtisphilippensis*wight	Ulmaceae	Bark	Digestion problems
24	*Centellaasiatica*L.	Mackinlayaceae	Leaves	Syphilis
25	*Chloroxylonswietenia*Roxb.	Rutaceae	Inner bark	Tooth problems
26	*Chenopodium album* Linn.	Chenopodiaceae	Leaves	Kidney stones

	*Cissampelospareira*L.	Menispermaceae	Leaves	Snake antidote
27	*Cocciniagrandis*(L)J.voigt	Cucurbitaceae	Leaves, tubers	Throat pain
28	*Cocciniaindica*	Cucurbitaceae	Roots	Antidote
29	*Colocassiaesculenta*(Linn.) Schott. &Endl.	Araceae	Leaves	Stomach disorder
30	*Cordiamonoica*Roxb.	Boragianaceae	Leaves	Chest pains
31	*Curcuma pseudomontana*J.Graham.	Zingiberaceae	Gingers	Wounds and cuts
32	*Curcuma neilgherrensis*wight	Zingiberaceae	Rhizome	Anti diabetic
33	*Cyanodondactylon*L.	Poaceae	Fibre	Headache
34	*Daturametel*L.	Solanaceae	Leaves	Pain relief
35	*Dichrostachysscinerea*Wight *et al.*	Mimosaseae	Fibre paste	Vomiting
36	*Dodonaea viscose* (Linn.) Jacq.	Sapindaceae	Leaves	Joint sprains, Fractures
37	*Elaeagnuskologas*chlecht.	Elaeagnaceae	Leaves	Antifeedants
38	*Erythroxylonmonogynum*Roxb.	Erythroxylaceae	Bark	Skin disorder
39	*Gaultheria fragrantissima*Wall.	Ericaceae	Leaves	Antiseptic
40	*Givotiamollucana*L.	Euphorbiaceae	Bark	Breathing problems
41	*Gmelinaarborea*Roxb.	Verbenaceae	Leaves	Stomach ache
42	*Hibiscus micranthus*L.f.	Malvaceae	Roots	Swellings over body
43	*Ipomeaobscura*(L.) Ker Gawl.	Convolvulaceae	Leaves	Sprain, stomach ache
44	*Jasminumauriculatum*Vahl.	Acanthaceae	Stems& roots	Bone fractures
45	*Jatrophacurcas*L.	Euphorbiaceae	Inner bark	Cold and fever
46	*Leucasaspera*(Willd.) Link	Lamiaceae	Whole Plant	Typhoid
47	*Manilkarahexandra(*Roxb.)Dubard.	Sapotaceae	Bark	Hip pains
48	*Moringaconcanensis*	Moringaceae	Bark & leaves	De-worming, Dysentery & fever
49	*Narinjicrenulata*(Roxb.) Nicols.	Rutaceae	Leaves	Leg pains
50	*Nerium oleander* L.	Apocyanaceae	Leaves	For speech to children
51	*Partheniumhysterophorus*L.	Asteraceae	Leaves	Cuts and burns
52	*Phyllanthusdebilis*kleinex wild	Euphorbiaceae	Leaves	Jaundice
53	*Pleiospermumalatum*Wight&Arn.	Rutaceae	Bark	Chest pains
54	*Prunella vulgaris* Linn.	Lamiaceae	Roots	Hematinic
55	*Raphidophorapertusa*Hassk	Araceae	Whole Plant	Swellings in groin joints
56	*Ricinuscommunis*L.	Euphorbiaceae	Seed oil	Dysentery
57	*Sapindusemarginata*Vahl.	Sapindaceae	Inner bark	Tooth problems
58	*Siegesbeckiaorientalis*Linn.	Asteraceae	Leaves	Insect bites & rashes
59	*Solanumnigrum*L.	Solanaceae	Whole Plant	Stomach ache& fever
60	*Solanumsurattense*Burm.F.	Solanaceae	Fruits, leaves	Vomiting &Tooth paste
61	*Tephrosiapurpurea*(Linn.)Pers.	Fabaceae	Leaves	Antitumor
62	*Terminaliachebula*Retz.	Combretaceae	Fruits	Cough and Fever
63	*Wattakakavolubilis*(Linn.F)stapf.	Asclepiadaceae	Leaves	Dysentery
64	*Xanthium indicum J*. Koenig ex Roxb.	Asteraceae	Leaves	Dog bite
65	*Ziziphusmauritiana*Lamk	Rhamnaceae	Bark	Dysentery
66	*Ziziphusrugosa*Lamk	Rhamnaceae	Bark	Dysentery

Table 2. List of edible plants used by Kota tribal in study area.

S.No	ScientificName	Family	Tamil Name	Edible Part
1	*Acacia pennata*(L.)Willd.	Mimosaceae	Seengai	Leaf
2	*Alternantherasessilis*(L.) R. Br. ex DC.	Amaranthaceae	Ponnakanni	Leaf
3	*Amaranthuscaudatus*L.	Amaranthaceae	keeraiThandu	Leaf
4	*Amaranthusgraecizans*L.	Amaranthaceae	Sirukeerai	Leaf
5	*Amaranthusspinosus*L.	Amaranthaceae	Mullu	Leaf
6	*Amaranthusviridis*L.	Amaranthaceae	Pattikerae	Leaf

7	*Asparagus racemosus*Willd.	Liliaceae	Neervekkaea	Tuber
8	*Nastusborbonicus*J.F.Gmel.	Poaceae	Periamungil	Shoot
9	*Basella alba* L.	Basellaceae	Vasaladagu	Leaf
10	*Boerhaviadiffusa*L.	Nyctaginaceae	Serandai	Leaf
11	*Brassica juncea*(L.) Czern.	Brasscicaceae	Kadugu	Leaf
12	*Cansjerarheedii*J.F.Gmel.	Opiliaceae	Povi	Leaf
13	*Canthiumcoromandelicum*Alston	Rubiaceae	Bellakarai	Fruit
14	*Cappariszeylanica*L.	Capparaceae	Kevisi	Fruit
15	*Caralluma bicolor Ramach,* J. *et al.,*	Asclepiadaceae	Kattalae	Shoot
16	*Cardiospermumhalicacabum*L.	Sapindaceae	Sitiki	Leaf
17	*Carissa carandas*L.	Apocynaceae	Kallakai	Fruit
18	*Carissa spinarum*L.	Apocynaceae	Sirukallakai	Fruit
19	*Celosia argentea*L.	Amaranthaceae	Pannae	Leaf
20	*Cereus pterogonus*Lem	Cactaceae	Oocikalli	Flower
21	*Cissusquadrangularis*L.	Vitaceae	Naralai	Leaf
22	*Cocciniagrandis*(L.) Voigt	Cucurbitaceae	Kovakai	Fruit
23	*Commelinabenghalensis*L.	Commelinaceae	Kannae	Leaf
24	*Cordiasinensis*Lam.	Boraginaceae	Sellai	Leaf & Fruit
25	*Cordiadichotoma*G.Forst.	Boraginaceae	Karadisellai	Fruit
26	*Cycascircinalis*L.	Cycadaceae	Enthu	Tuber & tender leaf
27	*Decalepishamiltonii*Wight &Arn.	Asclepiadaceae	Magalie	Tuber
28	*Digeramuricata*(L.) Mart.	Amaranthaceae	Theyya	Leaf
29	*Dioscoreaoppositifolia*L.	Dioscoreaceae	Riya	Tuber
30	*Dioscoreatomentosa*J.König ex Spreng.	Dioscoreaceae	Noorai	Tuber
31	*Diospyrosmontana*Roxb.	Ebenaceae	Bankini	Leaf
32	*Diospyrosmalabarica*(Desr.) Kostel.	Ebenaceae	Benson	Fruit
33	*Drypetessepiaria*Wight &Arn.	Euphorbiaceae	Thanuvam	Fruit
34	*Elaeagnusconferta*Roxb.	Elaeagnaceae	Kolaga	Fruit
35	*Ficusbenghalensis*L.	Moraceae	Aal	Fruit
36	*Ficusracemosa*L.	Moraceae	Athi	Fruit
37	*Glycosmispentaphylla*(Retz.) DC.	Rutaceae	Melaekulukki	Fruit
38	*Grewiahirsuta*Vahl	Tiliaceae	Kallai	Fruit
39	*Grewiatiliifolia*Vahl	Tiliaceae	Lumma	Fruit
40	*Grewiavillosa*Willd.	Tiliaceae	Jenukallai	Fruit
41	*Hemidesmusindicus*(L.)	Asclepiadaceae	Nannari	Tuber
42	*Ipomoea staphylina*Roem. &Schult.	Convolvulaceae	Unnagodi	Tuber
43	*Jasminumtrichotomum*B.Heyneex Roth	Oleaceae	Malligai	Leaf
44	*Lantana camara*L.	Verbenaceae	Unnichedi	Fruit
45	*Madhucalongifolia*J.F.Macbr.	sapotaceae	Lippae	Fruit
46	*Mangiferaindica*L.	Anacardiaceae	Manga	Fruit
47	*Moringaoleifera*Lam.	Moringaeceae	Nugae/Murungai	Leaf
48	*Murrayakoenigii*(L.) Spreng.	Rutaceae	Kariveppilai	Leaf
49	*Opuntiamonacantha*(Willd.) Haw.	Cactaceae	Kalli	Fruit
50	*Opuntiastricta*(Haw.) Haw.	Cactaceae	Chappathikalli	Fruit
51	*Oxalis corniculata*L.	Oxalidaceae	Pulichera	Leaf
52	*Pachygoneovata*(Poir.) Diels	Menispermaceae	Varinkodi	Fruit
53	*Phoenix loureiroi*Kunth	Arecaceae	Eechipullu	Tender shoot & fruit
54	*Phyllanthusemblica*L.	Euphorbiaceae	Nelli	Fruit
55	*Phyllanthusindofischeri*Bennet	Euphorbiaceae	Nelli	Fruit
56	*Phyllanthusreticulatus*Poir.	Euphorbiaceae	Poola	Fruit
57	*Physalisangulata*L. var. angulata	Solanaceae	Potolai	Fruit
58	*Pithecellobiumdulce*(Roxb.) Benth.	Mimosaceae	Konapuli	Fruit
59	*Portulacaoleracea*L.	Portulacaceae	Goni	Leaf
60	*Psydraxdicoccos*Gaertn.	Rubiaceae	Oppai	Fruit
61	*Riveahypocrateriformis*Choisy	Convolvulaceae	Mustae	Leaf
62	*Schleicheraoleosa*(Lour.) Merr.	Sapindaceae	Pulipoocha	Fruit
63	*Scutiamyrtina*(Burm.f.) Kurz	Rhamnaceae	Sodalie/Julie	Fruit

64	*Sennatora*(L.) Roxb.	Caesalpiniaceae	Oosithagarai	Leaf
65	*Solanumamericanum*Mill.	Solanaceae	Kakaedagu	Leaf
66	*Solanumvirginianum*L.	Solanaceae	Kandakathiri	Fruit
67	*Solanumrudepannum*Dunal	Solanaceae	Sundai	Fruit
68	*Strychnospotatorum*L.f.	Loganiaceae	Sillakottai	Fruit
69	*Syzygiumcuminii*(L.) Skeels	Myrtaceae	Neera/Naval	Fruit
70	*Tamarindusindica*L.	Caesalpiniaceae	Puli	Fruit
71	*Zaleyadecandra*(L.) Burm. f.	Portulacaceae	Konidagu	Leaf
72	*Ziziphusmauritiana*Lam.	Rhamnaceae	Lanthai	Fruit
73	*Ziziphusoenopolia*(L.) Mill.	Rhamnaceae	Julie	Fruit
74	*Ziziphusabyssinica*Hochst. exA.Rich.	Rhamnaceae	Kottae	Fruit

Table 3. List of families with number of species in study area.

S.NO	Name of the Family	Number of Species
1	Acanthaceae	04
2	Alangiaceae	01
3	Amaranthaceae	08
4	Anacardiaceae	01
5	Apiaceae	01
6	Apocynaceae	03
7	Araceae	03
8	Arecaceae	02
9	Asclepiadaceae	04
10	Asteraceae	03
11	Basellaceae	01
12	Berberidaceae	01
13	Boraginaceae	03
14	Brasscicaceae	01
15	Cactacea	03
16	Capperaceae	03
17	Caesalpiniaceae	03
18	Chenopodiaceae	01
19	Combretaceae	02
20	Commelinaceae	01
21	Convolvalaceae	04
22	Cucurbitaceae	03
23	Cycadaceae	01
24	Dioscoreaceae	02
25	Ebenaceae	02
26	Elaegnaceae	02
27	Ericaceae	01
28	Erythroxylaceae	01
29	Euphorbiaceae	08
30	Fabaceae	02
31	Lamiaceae	02
32	Liliaceae	01
33	Loganiaceae	01
34	Mackinlayaceae	01
35	Malvaceae	01
36	Meliaceae	01
37	Menispermaceae	02
38	Mimosaceae	04
39	Moraceae	02
40	Moringaceae	02
41	Nyctaginaceae	01
42	Oleaceae	01
43	Opiliaceae	01
44	Oxalidaceae	01
45	Poaceae	02
46	Portulacaceae	02
47	Rhamnaceae	06
48	Rubiaceae	03
49	Rutaceae	07
50	Sapindaceae	04
51	Sapotaceae	02
52	Solanaceae	07
53	Tiliaceae	03
54	Ulmaceae	01
55	Verbinaceae	03
56	Vitaceae	01
57	Xanthorhoaeaceae	01
58	Zingberaceae	02
	Total	140

Fig. 1. Location of the study area

Fig. 2 Overview of the study area.

Fig. 3. Preparation of herbal products by Kota tribal in study area

Fig. 4. Medicinal plants used by Kota tribal in study area.

The collected plants are having medicinal properties, which is constructed towards the plant parts like stem, root, leaf and bark etc. Each and every plant differ from mode of utilization as a medicinal and edible food to the human beings and cattle.

4. CONCLUSION

In order to study that the traditional uses of these folk medicinal practice day todays life it as resulted providing information of 66 wild plants. Out of the 140 species are comprised in the families like Acanthaceae, Amaranthaceae, Convolvalaceae, Euphorbiaceae, Rutaceae, Solanaceae, etc.,. In this case study, they are used 66 plants in medicinal purpose and 74 plants are used as edible food respectively. So this investigation is held us to understand how indigenous knowledge possess by Kota tribal of study area.

Since most of ethylic communities do not have their own script and return languages the information about the medicinal plants, their dosage, attitude towards disease are unclimbed. So our study is suggested that it is essential to collect information about the use of medicinal plants by the traditional healers and document the same to study them scientifically.

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INVASIVE PLANTS - A BOON OR BANE TO THE LEPIDOPTERON FAUNA: CONSERVATION AND MANAGEMENT PLAN SUGGESTIONS

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ABSTRACT

Butterfly diversity was recorded from Nov (2013) - May (2014) in Pookode region. A total number of 128 species recorded from the five families; Nymphalidae (46 species) Lycaenidae (28 species), Hesperiidae (22 species), Pieridae (17 species) and Papilionidae (15 species) respectively. During the survey invasive plant species were also recorded. There were 36 species of invasive plants from 18 families identified from the study area. More butterflies were attracted towards nectar offering invasive plants. *Chromolaena odorata, Ipomea cairica, Lantana camara, Merremia vitifolia, Mikania micrantha, Mimosa diplotricha, Pennisetum polystachyon, Pteridium aquilinum, Quisqualis indica* and *Sphagneticola trilobata* were the major invasive plants found in the Pookode region and their flower attracts butterfly for pollination. Even though nectar offered by the plants are supportive for growth, in long run these species can affect butterfly population by declining native host larval plant species for butterfly reproduction. Invasive species compete with the native flora and reduce its population. Management practices like physical, chemical and modern bio control measures could be used for eradicating of invasive plants. Wise use of invasive plants for other economical purpose such as bio-fuel, medicinal purpose, bio-pesticide and handicraft could be suggested. Successful management of invasive species are needed for conserving Lepidoptera fauna and other native biota of the area.

Keywords: Butterflies, invasive plants, host plants, management practices, conservation.

1. INTRODUCTION

Arthropods occupy half of earth's biodiversity (May, 1992) among these, butterflies fascinate the most. Their interaction with the ecosystem as pollinators and herbivorous are notable (Tiple *et al..,* 2006). They are highly sensitive to solar radiation, temperature and variations in micro habits (Thomas *et al..,* 1998). Anthropogenic disturbance and habitat quality variation (Kocher and Williams, 2000) reflects butterfly lifestyle, because of these reasons butterflies chose good candidate as bio-indicators to access habitat fragmentation, soil degradation and water pollution (Kehimkar, 2000). The Indian subcontinent hosts about 1,504 species of butterflies, and Western Ghat hosts 351species of butterflies (Smetacek, 1992; Gaonkar, 1996; Kunte, 2009; Roy *et al.,* 2010and Tiple, 2011). The amount of the Indian butterflies is one fifth of the world butterflies (Kunte, 2000).The diversity and distribution of a particular species of butterfly is dependent not only on the geography of the area and the ability of the species to move around within it, but also on the ecological demands of the species (Khan *et al.,* 2011).

Many of the butterflies are strictly seasonal and prefer particular set of habitat (Kunte, 1997). Butterflies and plants have intimate relationship, as food source and as larval host plants. (Feltwell, 1986). Butterfly diversity and abundance would be more in that vegetation which offers these. Invasion of invasive species were noted during the survey. Showy flowers of invasive species may draw pollinators (Armbruster and Herzig, 1984). This reduces the reproductive capacity of native plants (Brown 2002).

2. METHODOLOGY

Population survey of Lepidoptera were conducted monthly once between Nov (2013) May (2014) in the campus using line pollard walk method (Pollard, 1977). Survey was conducted from 8.00AM to 11.00 AM during the peak activity of butterflies. Species were identified through direct observation, photographs, eggs, pupa and larval forms with the help of field guides (Wynder-Blyth, 1957; K. Kunte, 2000; Kehimkar, 2008; George M, 2011)

2.1. Study area

Pookode located in Vythiri Panjayath which is southern part of Wayanad District. Pookode has mixed vegetative types including grassland, moist deciduous forest, semi-evergreen forest, plantations, rocky areas and riverine streams. Altitude varies 745-930 meter from the sea level and average temperature is about 25.75^{o}C and annual rainfall is 5318 mm.

Study area hosts several types of vegetation, semi-evergreen patches were found adjacent to plantation (mainly coffee and tea) with large trees in between. Invasive species like *Chromolaena odorata* and *Mikania micrantha* were also observed along with the other native vegetation. Scrub land consists of open hilly terrains along with grassland habitat towards the summit of the Pookode region. Grasses such as *Cymbopogon citrates* and trees like *Careya arborea* dominate the habitat. *Lantana camara* and *Chromolaena odorata* are the dominating invasive species in the scrub land habitat. Riparian habitats run along the streamlets of Vythiri River towards the base of the Pookode where reeds are dominating the vegetation. *Sphagneticola trilobata* were the major invasive vegetation in riverine habitat.

3. RESULTS AND DISCUSSION

A total number of 128 species (Table.1) recorded from the five families. Nymphalidae (46 species) is the most abundant and Papilionidae (15 species) is the least abundant. Lycaenidae (28 species), Hesperidia (22 species), Pieridae (17 species) recorded respectively (Fig:1).

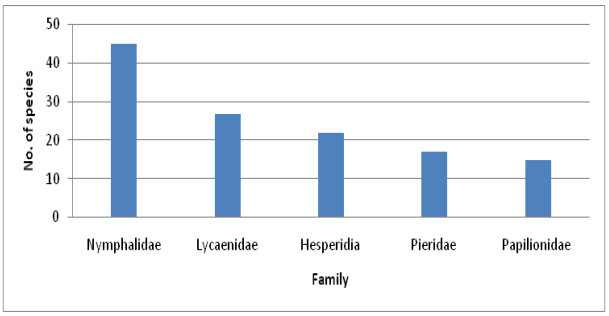

Fig. 1: Family wise abundance in the butterfly species in the Pookode region.

The Pookode region host rich Lepidoptera diversity and abundance. Many of the species recorded in the region are of conservational importance. Fourteen species belongs to scheduled list of Indian Wildlife protection act 1972 Scheduled I; *-Atrophaneura hector, Papilio liomedon, Hypolimnas misippus,* Scheduled II*; Papilio Buddha, Kallima horsfieldi, Euthalia aconthea, Libythea lepita, Tanaecia lepidea, Discophora lepida, Appias albino, Spindasis lohita, Lampides boeticus,* Scheduled IV;- *Prioneris sita, Tarucus ananda.* 10 species were endemic to the Western Ghats they are *Troides minos, Kallima horsfieldi, Idea malabarica, Curetis siva, Aeromachus pygmaeus, Zipaetis saitis* (Western Ghats and SriLanka), *Papilio buddha, Papilio liomedon, Discophora lepida, Discophora lepida, Mycalesis patina.* Occurrence of Blue Nawab (*Polyura schreiber*) was a rare record in the state. Hence the area must be conserved for promoting Lepidoptera diversity.

Threats faced by butterflies in the area are urbanization and construction activities leading to habitat fragmentation that force butterflies to settle in narrow habitats causing population decline. Cattle grazing were another threat in the area where larval host plants are grazed by cattle which affect butterfly population (Runquist, 2011). But threats due to invasive plant species were considered higher than the others.

There is an intimate relationship between butterflies and plants (Feltwell, 1986), butterflies needs plants as food source and as larval host plants where as plants need these insects for pollination

Butterflies were found to feed on nectars of invasive plant species like *Chromolaena odorata, Ipomea cairica, Lantana camara, Merremia vitifolia, Mikania micrantha, Mimosa diplotricha, Pennisetum polystachyon, Pteridium aquilinum, Quisqualis indica* and *Sphagneticola trilobata* etc. Most of these plants provide nectar throughout the year (Nimbalkar *et al.,* 2011) to the butterflies but none of these invasive plants host butterfly larval forms of single species of butterflies.

Egg laying of Acacia Blue butterfly were observed in *Mimosa invasia* during the survey. *Acheronita styx* (Death's headed hawk moth) laying egg in *Lantana camara* was reported by Kehimkar, 2000, but prefer less. A total 36 species of invasive plants recorded (Table: 2) from the study area among the plants *Chromolaena odorata, Clidemia hirta, Lantana camara, Leucaena leucocephala and Mikania micrantha* enlisted in IUCN world 100 worst invaders because of its ability to dominate and devastate native biota (Lowe *et al.*. 2000).

Invasive plants are second largest threat to the biodiversity after habitat destruction (Enserink, 1999). Many of the invasive species become invades and explore higher than in their native regions. (D'Antonio and Vitousek 1992; Ridenour and

Callaway 2001; Louda *et al.*, 2003). These invasive species can cause large decreases in the abundances of native species (Braithwaite *et al.*. 1989; Memmott *et al.*. 2000; Grigulis *et al.*. 2001). Invasive species compete with native species in different ways including competition for nutrients (Wardle *et al.,* 1994), Water (Delph 1986), Light (Grace and Wetzel 1981, 1982, Weihe and Neely 1997), space (Agren and Fagerstrdm 1980, Newsome and Noble 1986), competitive release, and predatory release (Rodriguez, 2006). These competitions may reduce the ability of native species to maintain or increase population size (Huenneke and Thomson 1995).

Beyond such vegetative competition, competition for pollinator services by invasive plants may also reduce the reproductive capacity of native plants (Brown, 2002). More butterflies were observed in the areas where high populations of *Lantana camara, Mikania micaranta*and *C. odorata* were present. An experimental study showed that butterflies are more attracted to amino acid contacting nectar provided by *L. camara*. (Alm, 1990). Some substances produced by the allelopathic effect of invasive species like *Lantana camara,* (Sharma *et al.,* 2007., Kumbhar and Patel 2013 Mishra 2013, 2014, Gantayet *et al.,* 2014.). *C. odorata and Mikania micaranta* (Sahid, 2014)are well documented Organic substances produce by plants as secondary metabolites such as alkaloids, Phenoics , flavonoids, Terpenoids and Glucosinolates are known to inhibit the seed germination, growth and development of other species (Rice,1974; Day *et al*..,2003)

Showy invasive species may draw pollinators away from native species, decreasing visit quantity (Free, 1968, Waser, 1978a, Gross and Werner 1983, Armbruster and Herzig, 1984) hence pollinations by butterflies and other insects were more in invasive plants thereby improving their propagation. Research shows native species suffers significantly reduced seed set in the presence of an aggressive invading congener when the species share the same kind of pollinators (Brown, 2002).

3.1. Major invasive plants and its invasion in the study area

Lantana was the major invasive plant in the study area. It was introduced as an ornamental plan into many tropical and subtropical world from its native south and Central America during nineteenth and early twentieth century (Mack *et al.*. 2000). Thereafter like all other invasive species Lantana had established causing threat to biodiversity (Hiremath and Sundaram., 2005). It is having high regeneration capacity and can also survive in degraded soils (Bhatt *et al.,* 1994; Rawat *et al.,* 1994). Lantana is exceedingly efficient at nutrient uptake and use, enabling it to grow on highly impoverished soils (Bhatt *et al.*, 1994; Rawat *et al.,* 1994) Lantana may be favored by disturbances such as fire and grazing (Duggin and Gentle 1998; Gentle and Duggin, 1998).

Another important invasive species in the study area was *Chromolaena odorata* (L.) (Asteraceae). Florets of these plants attract butterflies and form an important nectar source for adult butterflies (Lakshmi and Raju, 2011). A study in Bangladesh showed 55 species of butterflies use this plant as a source of nectar (Shihan and Kabir, 2015). Arrangement of florets provide convenient landing place for butterflies and a butterfly can probe several flowers at a time in single visit (Lakshmi and Raju, 2011). Hexose rich sugar and high amino acid concentration in Asteraceae plants can attract butterflies and other pollinators (Baker and Baker 1983., Galetto and Bernardello, 2003).

Clidemia hirta, commonly called Koster's Curse which is a native Tropical America listed under IUCN 100 worst invasive species was another invasive species found during the survey. They are densely branched shrub up to 5 m tall, normally between 0.5 and 3 m. *C. hirta* have pinkish white flowers and dark blue berries. It is an aggressive colonizer which can produce 500 berries which contain 100 seeds per fruit.

Mikania micrantha one among the worst invasive plants of the World which belongs to the family Asteraceae (Lowe *et al.,* 2000). There are of 250 species in this genus Mikania however 4 species are known to be invasive. Among these *Mikania micrantha* is the only invasive plant in Asia-Pacific region. This is an invading creeper can grow 8-9 cm a day and able to create a thick envelope over the native biota eventually devastate native plants by blocking sunlight and its allelopathic effect. Flowers are good nectar source for many insects including butterflies which accelerate the pollination and spreading of the Mikania.

3.2. Removal and alternative uses of Invasive plant species

Past hundred years about 40 species of pathogens and insects tried on Lantana as bio control agents but none of them can acquire significant effect on Lantana (Sankaran *et al.,* 2010).

Here the importance of biofuel production from *Latana camara.* Bioethanol property of *Lantana camera* (Ramesh *et al.,* 2010) and its low cost production were identified. An industrial level production of biofuel can make significant control over the Lantana. Further research are needed to identify similar characteristics of other invasive plants.

A management method that involves manual or mechanical means to remove or alter growing conditions of invasive plants are termed physical methods. This method prevent invasive plant establishment, as when soils are frequently hoed or tilled to disturb the soil seed bank and uproot seedlings (Radosevich *et al.*, 1997). After any physical treatment, it is important to inspect tools and equipment and to safe disposal (burning) of invasive plant to prevent propagation to new sites (Holloran *et al.*, 2004). Physical removal or destruction of invasive plants can often be the first, simplest, and most cost effective response to a small new population (Venner, 2006).

Another method involves use of Chemical herbicides to manage invasive plants. Herbicides can efficiently and effectively suppress or kill unwanted plants but should be used judiciously, safely, and in a way that minimizes adverse effects on non-target resources. (D'Antonio *et al.*, 2004)

Biocontrol was a new technological approach towards irradiation of invasive plants. Biological control (or biocontrol) reunites invasive plants with their enemies to restore natural controls and reduce dominance of invasive plants within the plant community. Any plant populations are regulated by their environment and the influence of natural enemies (Crawley 1997). Since no potential enemies are present for invasive species, they flourish in the invaded area. Absence of natural enemies contributes to the invasiveness of some nonnative plants (Keane and Crawley, 2002). Feeding of Lantana leaves by Death faced hawk moth larvae (*Acheronita styx*) is reported (Kehimkar, 2000) which can be used as natural predator of the invasive species. Insect like *Teleonemia scrupulosa* and fungus pathogens *Prospodium tuberculatum* can create dominance over Lantana in some places (Sankaran *et al.,* 2010). The strong shoots of Lantana can be used for making handicrafts and furniture. A combined effort of bio-control, chemo-control and mechanical control measures is the best method to devastate Lantana of Pookode region.

Importing of *Layothrips mikania* from the Tridnad failed to adapt with the climatic condition of Solomon Islands and Malaysia against *Mikania micrantha*, but the fungal pathogens *Paksinia spegastini* can create serious effect on Mikania. This pathogens can creates disease only to the Mikania is another advantage (Sankaran *et al.*, 2010).

Table 1. List of Butterflies species recorded in the survey conducted in Pookode region.

S. No.	Common name	Scientific name	Status	Wildlife Protection Act 1972	Western ghat endemics
		Papilionodae (Tailed butterflies)			
1	BLUE MORMON	*Papilio polymnestor (Cramer)*			
2	COMMON BLUEBOTTLE	*Graphium sarpedon (Linnaeus)*			
3	COMMON JAY	*Graphium doson (C. and R. Felder)*			
4	COMMON MORMON	*Papilio polytes (Linnaeus)*			
5	COMMON MIME	*Chilasa clytia (Linnaeus)*			
6	COMMON ROSE	*Atrophaneura aristolochiae (Fabricius)*			
7	CRIMSON ROSE	*Atrophaneura hector (Linnaeus)*		S1	
8	LIME BUTTERFLY	*Papilio demoleus (Linnaeus)*			
9	PARIS PEACOCK	*Papilio paris (Linnaeus)*			
10	RED HELEN	*Papilio helenus (Linnaeus)*			
11	MALABAR BANDED PEACOCK	*Papilio buddha (Westwood)*	R	S2	WE

12	MALABAR BANDED SWALLOWTAIL	*Papilio liomedon (Moore)*	R	S1	WE
13	MALABAR ROSE	*Atrophaneura pandiyana (Moore)*			WE
14	SOUTHERN BIRDWING	*Troides minos (Cramer)*			WE
15	TAILED JAY	*Graphium agamemnon (Linnaeus)*			
		Nymphalidae (Brushfooted butterflies)			
16	BAMBOO TREEBROWN	*Lethe europa (Fabricius)*			
17	BLACK PRINCE	*Rohana parisatis (Westwood)*	R		
18	BLUE NAWAB	*Polyura schreiber (Godart)*	R		
19	SOUTH INDIAN BLUE OAKLEAF	*Kallima horsfieldi (Kollar)*	R	S2	WE
20	BLUE ADMIRAL	*Kaniska canace (Linnaeus)*			
21	BLUE PANSY	*Junonia orithiya (Linnaeus)*			
22	BLUE TIGER	*Tirumala limniace (Cramer)*			
23	CHOCOLATE PANSY	*Junonia iphita (Cramer)*			
24	CLIPPER	*Parthenos sylvia (Cramer)*			
25	COMMON BARON	*Euthalia aconthea (Cramer)*		S2	
26	COMMON BEAK	*Libythea lepita (Moore)*		S2	
27	COMMON BUSHBROWN	*Mycalesis perseus (Fabricius)*			
28	COMMON CASTOR	*Ariadne merione (Cramer)*			
29	COMMON EVENING BROWN	*Melanitis leda (Linnaeus)*			
30	COMMON FIVERING	*Ypthima baldus (Fabricius)*			
31	COMMON FOURRING	*Ypthima huebneri (Kirby)*			
32	COMMON INDIAN CROW	*Euploea core (Cramer)*			
33	COMMON LASCAR	*Pantoporia hordonia (Stoll)*			
34	COMMON MAP	*Cyrestis thyodamas (Boisduval)*			
35	COMMON LEOPARD	*Phalanta phalantha (Drury)*			
36	COMMON NAWAB	*Polyura athamas (Drury)*			
37	COMMON PALMFLY	*Elymnias hypermenstra (Lennaeus)*			
38	COMMON SAILER	*Neptis hylas (Linnaeus)*			
39	COMMON SERGEANT	*Athyma perius (Linnaeus)*			
40	COMMON TREEBROWN	*Lethe rohria (Fabricius)*			
41	CRUISER	*Vindula erota (Fabricius)*	R		
42	DANAID EGGFLY	*Hypolimnas misippus (Linnaeus)*		S1	
43	DARK BLUE TIGER	*Tirumala septentrionis (Butler)*			
44	DARK EVENING BROWN	*Melanitis phedima (Cramer)*			
45	GLADEYE BUSHBROWN	*Mycalesis patnia (Moore)*			Western Ghats and Sri Lanka

46	GLASSY TIGER	*Parantica aglea (Stoll)*			
47	GREAT EGGFLY	*Hypolimnas bolina (Linnaeus)*			
48	GREY COUNT	*Tanaecia lepidea (Butler)*		S2	
49	GREY PANSY	*Junonia atlites (Linnaeus)*			
50	LEMON PANSY	*Junonia lemonias (Linnaeus)*			
51	MALABAR TREE NYMPH	*Idea malabarica (Moore)*	R		WE
52	NIGGER	*Orsotrioena medus (Fabricius)*			
53	RUSTIC	*Cupha erymanthis (Drury)*			
54	SOUTHERN DUFFER	*Discophora lepida (Moore)*	R	S2	WE
55	STRIPED OR COMMON TIGER	*Danaus genutia (Cramer)*			
56	TAMIL CATSEYE	*Zipaetis saitis (Hewitson)*			WE
57	TAMIL YEOMAN	*Cirrochroa thais (Fabricius)*			
58	TAWNY COSTER	*Acraea violae (Fabricius)*			
59	PLAIN TIGER	*Danaus chrysippus (Linnaeus)*			
60	WHITEBAR BUSHBROWN	*Mycalesis anaxias (Hewitson)*			
61	YELLOW PANSY	*Junonia hierta (Fabricius)*			
		Pirridae (Whites and Yellows)			
62	INDIAN CABBAGE WHITE	*Pieris canidia (Sparrman)*			
63	COMMON ALBATROSS	*Appias albina (Boisduval)*		S2	
64	COMMON EMIGRANT	*Catopsilia pomona (Fabricius)*			
65	COMMON GRASS YELLOW	*Eurema hecabe (Linnaeus)*			
66	COMMON GULL	*Cepora nerissa (Fabricius)*			
67	COMMON JEZEBEL	*Delias eucharis (Drury)*			
68	COMMON WANDERER	*Pareronia valeria (Carmer)*			
69	LESSER ALBATROSS	*Appias wardi (Moore)*	R	S2	WE
70	GREAT ORANGE TIP	*Hebomoia glaucippe (Linnaeus)*			
71	MOTTLED EMIGRANT	*Catopsilia pyranthe (Linnaeus)*			
72	ONE-SPOT GRASS YELLOW	*Eurema andersonii (Moore)*			
73	PAINTED SAWTOOTH	*Prioneris sita (C. and R.Felder)*	R	S4	
74	PSYCHE	*Leptosia nina (Fabricius)*			
75	SMALL GRASS YELLOW	*Eurema brigitta (Cramer)*			
76	SPOTLESS GRASS YELLOW	*Eurema laeta (Boisduval)*			
77	THREE-SPOT GRASS YELLOW	*Eurema blanda (Boisduval)*			
78	YELLOW ORANGE TIP	*Ixias pyrene (Linnaeus)*			
		Lycanidae (Blues)			
79	APEFLY	*Spalgis epius (Westwood)*			

80	COMMON ACACIA BLUE	*Surendra quercetorum*			
81	COMMON CERULEAN	*Jamides celeno (Cramer)*			
82	COMMON HEDGE BLUE	*Acytolepis puspa (Horsfield)*			
83	COMMON IMPERIAL	*Cheritra freja (Fabricius)*			
84	COMMON PIERROT	*Castalius rosimon (Fabricius)*			
85	COMMON SILVERLINE	*Spindasis vulcanus (Fabricius)*			
86	DARK CERULEAN	*Jamides bochus (Stoll)*			
87	DARK GRASS BLUE	*Zizeeria karsandra (Moore)*			
88	DARK PIERROT	*Tarucus ananda (de Niceville)*		S4	
89	FORGET-ME-NOT	*Catochrysops strabo (Fabricius)*			
90	GRAM BLUE	*Euchrysops cnejus (Fabricius)*			
91	GRASS JEWEL	*Freyeria trochylus (Freyer)*			
92	INDIAN CUPID	*Everes lacturnus (Godart)*			
93	LESSER GRASS BLUE	*Zizina otis (Fabricius)*			
94	LIME BLUE	*Chilades lajus (Stoll)*			
95	LONG-BANDED SILVERLINE	*Spindasis lohita (Horsfield)*		S2	
96	MALAYAN	*Magisba malaya (Horsfield)*			
97	MONKEY PUZZLE	*Rathinda amor (Fabricius)*			
98	Line blue sp	*Nacaduba* sp.			
99	PEA BLUE	*Lampides boeticus (Linnaeus)*		S2	
100	PLUM JUDY	*Abisara echerius (Stoll)*			
101	INDIAN RED FLASH	*Rapala iarbus (Fabricius)*			
102	RED PIERROT	*Talicada nyseus (Guerin-Meneville)*			WE
103	SHIVA'S SUNBEAM	*Curetis siva (Evans)*	R		
104	SLATE FLASH	*Rapala manea (Hewitson)*			
105	TINY GRASS BLUE	*Zizula hylax (Fabricius)*			
106	YAMFLY	*Loxura atymnus (Stoll)*			
		Hesperiidae (Skippers)			
07	BUSH HOPPER	*Ampittia dioscorides (Fabricius)*			
108	CHESTNUT BOB	*Iambrix salsala (Moore)*			
109	COMMON BANDED AWL	*Hasora chromus (Cramer)*			
110	COMMON BANDED DEMON	*Notocrypta paralysos (Wood-Mason and de Niceville)*			
111	INDIAN/COMMON DARTLET	*Oriens goloides (Moore)*			
112	COMMON REDEYE	*Matapa aria (Moore)*			
113	COMMON SMALL FLAT	*Sarangesa dasahara (Moore)*			
114	COMMON/CEYLON SNOW FLAT	*Tagiades jepetus (Stoll)*			

115	COMMON SPOTTED FLAT	*Celaenorrhinus leucocera (Kollar)*		
116	COON	*Sancus fuligo (Marbille)*		
117	FULVOUS PIED FLAT	*Psuedocoladenia dan (Fabricius)*		
118	GRASS DEMON	*Udaspes folus (Cramer)*		
119	INDIAN PALM BOB	*Suastus gremius (Fabricius)*		
120	INDIAN GRIZZLED/INDIAN SKIPPER	*Spialia galba (Fabricius)*		
121	DARK PALM DART	*Telicota ancilla (Herrich-Schaffer)*		
122	Unknown Dart	*Potanthus* sp.		WE
123	PYGMY GRASS-/SCRUB-HOPPER	*Aeromachus pygmaeus (Fabricius)*		
124	RESTRICTED DEMON	*Notocrypta curvifascia (C. R. Felder)*		
125	RICE SWIFT	*Borbo cinnara (Wallace)*		
126	DARK SMALL-BRANDED SWIFT	*Pelopidas mathias (Fabricius)*		
127	BROWN AWL	*Badamia exclamationis (Fabricius)*		
128	TAMIL GRASS DART	*Taractrocera ceramas (Hewitson)*		

S1-Scheduled I, Wildlife Protection Act 1972, S2-Scheduled II WPA 1972, S4- Scheduled IV WPA 1972, R- Rare, WE- Westerm Ghat Endemic

Table 2. List of invasive plants recorded in study area.

Si NO	Family	Scientific Name	Common Name	Native Place	Risk Level
1	Asteraceae	*Ageratina adenophore*	Crofton Weed	Central America	Medium Risk
2	Asteraceae	*Ageratum conyzoides*	Goat Weed	Central America	Low Risk
3	Amaranthaceae	*Alternanthera brasiliana*	Red calico Plant	Latin America	Low Risk
4	Amaranthaceae	*Amaranthus spinosus*	Prickly amaranthus	Central America	Low Risk
5	Iridacea	*Aristea ecklonii*	Blue Star	Africa	No risk
6	Asclepiadaceae	*Asclipias curassavica*	Blood flower	Tropical America	No risk
7	Asteraceae	*Bidens sulphurea*	Sulphus cosmos	North America and Africa	No risk
8	Solanaceae	*Brugmansia arborea*	White angel trumpet	South America	Medium Risk
9	Solanaceae	*Brugmansia Suaveolens*	Angel's Trumpet	Tropical and Subtropical America	No risk
10	Apocynaceae	*Catharanthus roseus*	Periwinkle	Madagascar	No risk
11	Asteraceae	*Centratherum intermedium*	Brazilian Button Flower	South America	No risk
12	Asteraceae	*Chromolaena odorata*	Siam weed	Tropical America	High Risk
13	Melanostomaceae	*Clidemia hirta*	Koster's curse	Tropical and Central America	Low Risk
14	Verbenaceae	*Duranta erecta*	Duranta curse	South America	No risk

15	Acanthaceae	*Hypoestes sanguinolenta*	Measles plant	Madagascar	Medium Risk
16	Lamiacea	*Hyptis suavelolens*	Pignut	Tropical America	Medium Risk
17	Convolvulaceae	*Ipomea cairica*	Railway creeper	Tropical Africa and Asia	High Risk
18	Verbenaceae	*Lantana camara*	Lantana	Central and South America	High Risk
19	Mimosaceae	*Leucaena leucocephala*	Lead tree	Tropical America	Low Risk
20	Onagraceae	*Ludwigia peruviana*	Prim rose tree	North America	Medium Risk
21	Rhamnaceae	*Maesopsis eminii*	Umbrella tree	West and Central Africa	Medium Risk
22	Convolvulaceae	*Merremia vitifolia*	Grape leaf wood rose	Indo Maleshya and China	High Risk
23	Asteraceae	*Mikania micrantha*	Mile-a-minute	South America	High Risk
24	Mimosaceae	*Mimosa diplotricha*	Giant sensitive plant	Tropical America	High Risk
25	Mimosaceae	*Mimosa pudica*	Touch-Me-Not	South America	Low Risk
26	Asteraceae	*Parthenium hysterophorus*	Congress grass	North and South America	Medium Risk
27	Poaceae	*Pennisetum pedicellutum*	Kyasuwa grass	Africa and Asia	Medium Risk
28	Poaceae	*Pennisetum polystachyon*	Mission grass	Tropical Africa	High Risk
29	Solanaceae	*Physalis angulata*	Sunberry	Tropical Africa, Asia, Australia	No Risk
30	Dennstaedticeae	*Pteridium aquilinum*	Broken fern	Tropical America	High Risk
31	Combretaceae	*Quisqualis indica*	Burma creeper	Mynamar	High Risk
32	Ceasalpiniaceae	*Senna occidentalis*	Coffee senna	South America	Low Risk
33	Ceasalpiniaceae	*Senna tora*	Sickle senna	South America	Medium Risk
34	Asteraceae	*Sphagneticola trilobata*	Singapore Daisy	Tropical America	High Risk
35	Asteraceae	*Tithonia diversiflora*	Mexican sunflower	Mexico and Central America	Medium Risk
36	Asteraceae	*Tridax procumbens*	Coat button	Tropical America	No risk

3.3. Bio pesticides and Fertilizer

Bio pesticide property of *Chromolaena odorata, Lantana camara*, plants were already identified. Industrial base production of bio pesticide from these plants may decrease its invasion and provide job to the communities depend on this.

It was reported that the compost of Mikania gives better yields in the paddy fields of Mizoram (Sankaran *et al*., 2010). Small scale industries could take up such initiatives. Hence removal of invasive weeds for the production of such products can lead to biodiversity conservation and also enhance economy.

3.4. Management

The diversity of butterflies for particular habitats is associated with the availability of larval host plants and adult nectar plants (Shihan and Kabir, 2015). Increase in nectar plant and decline in larval host plants may adversely affect butterfly population.

According to Rejmanek, 2003, three management objectives were suggested to weed

control; they are prevention/ exclusion, early detection, rapid assessment and control/ eradiation. No assessment in the percentage cover of invasive plants was done in the area. Knowledge about the status and range of invasive plant species would help in better management plants. Proper and systematic scientific studies would bring out effective ways to control invasive plants.

Use of Lantana as fencing and ornamental flower in garden should be discouraged. *Lantana* plants should not be planted in and around the crop fields (Gantayet *et al.,* 2014). Clearing lands with invasive plants, continual follow-up treatment to remove roots and seedlings would be effective way to control invasive plants (Gantayet *et al.*, 2014)

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SNAKE RESCUES; A CONSERVATION EFFORT IN KANNUR DISTRICT

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ABSTRACT

Snakes can be found near human habitation because of different reasons of which abundance of prey (rodents) is the major fact. This draws conflict between snakes and humans. Even though snakes are protected with Indian Wildlife Act of 1972, they are generally regarded dangerous creatures to man and whenever spotted deserve no mercy. Hence, recues of the snake is an important factor for conserving the species. Trends in the population of snakes are difficult to monitor due to its sporadic distribution and secretive nature of snakes. Lack of knowledge about the population concerns any conservational plans. This data attempt to document the diversity, population and seasonality of the snakes rescued in Kannur by Rapid response team from October 2011 to October 2014 in Kannur district.

A total of 1427 snakes comprising 16 species were rescued in Kannur district of which 65% were venomous snakes. Indian Spectacled Cobra (*Naja naja;* 44.1%) were found to be common venomous snake encountered in the district. Russell's Viper (*Daboia russelii;* 14.8%), Common Krait (*Bungarus caeruleus;* 3.4%), King Cobra (*Ophiophagus Hannah;*2.5%) and few cases of Malabar Pit-Viper (*Trimeresurus malabaricus;*0.1%), Common Cat Snake (*Boiga trigonata;*0.2%) and Forsten's Cat snake (*Boiga forsteni;*0.1%) are the other venomous species.. Indian Rock Python (*Python molurus;* 30.1%) was the commonly rescued non-venomous snake in Kannur. Other non-venomous snakes were Rat snake (*Ptyas mucosa*; 1.8%), Common Trinket snake (*Coelognathus helena;* 1.3%), Wolf snake (*Lycodon aulicus;* 0.4%), Common Kukri (*Oligodon arnensis;* 0.1%), Common sand boa (*Eryx conicus;* 0.3%) and Red sand boa (*Eryx johnii;* 0.5%). Seasonal variations in the number of rescued snakes were discussed. Knowledge of activity pattern of the snake in the district can be used for successful management and conservational plans. Waste management, rodent control, reducing hideout places etc were suggested to decrease the number of snakes entering into house compound. Promoting awareness about the local snake among the public is as important as rescue activities. The increase in rescue call by 40% in 2013 can be taken as one of the successes of the awareness programs conducted across the district.

Keywords: Snakes, awareness programs, conservation, Kannur District.

1. INTRODUCTION

Reptiles are one among the faunas that are adversely affected with anthropogenic development (Gibbons *et al*. 2000). Habitat deterioration and alterations had made too many reptile species to co-exist with the urban environment (McKinney, 2006). The number of snakes had risen in the outskirts of cities of which few snakes were found adapted with human habitations (Purkayastha *et al*. 2011). This had caused much conflict with humans and eventually snakes get killed when spotted. Malicious killing is one of the factors causing the decline in snake populations (Baruah and Sengupta, 1998). The layman kills snakes due to ignorance regarding environmental conservation, laws regarding the protection of snakes and the significance of snakes in nature (Vyas, 2013).

Conservation of snakes is as important like other species. Rescue activity of snakes was done by the forest department and like-minded people from long time in the district. Rapid Response team was set in 2011 by Kannur Forest Department with an aim to rescue and rehabilitate the wild animals which are in danger. Reptiles are an important component of an ecosystem since it act as both predator and prey for many species (Gibbons *et al*. 2000). Species richness is one of the essential components of a healthy ecosystem (Schmeller *et al.,* 2008 and Sfenthouraks, 2009). Since ecosystem provides direct services to humans, each species in an ecosystem is having an economic value. But the estimating of this economic value is difficult for many species (Loornis and White, 1996). Poor knowledge among the public regarding the common snakes and many misbelieve was reasons for killing

the snakes. Also, the amount of effort done by researchers and enthusiasts has not translated to get public support for snakes. Lack of knowledge about snakes population in the area is a drawback for any conservational and management plans. Since population surveys in snakes have many practical difficulties this article is written based on the available source of rescue data of snakes presenting the local diversity and abundance of snakes and commonly encountered snakes in the district.

2. METHODOLOGY

To study the local diversity, abundance of the species of snakes, I had requested permission from Rapid Response Team in Kannur Forest department who had regular records of rescues operations made in the district. The collected data included species of snakes and the month wise rescue from 2011-2014, which was then analyzed with the help of 'MS Excel'

3. RESULTS

About 16 species of snakes were rescued over a three-year period by the Rapid Response Team under Thaliparamba range of Kannur Forest Division of which venomous snakes (65%) were more compared to non-venomous snakes (35%). Commonly encountered venomous snakes were Spectacled Cobra (*Naja naja;* 44.1%) and Russell's viper (*Daboia russelii;* 14.8%). Other venomous species include Common Krait (*Bungarus caeruleus;* 3.4%), King Cobra (*Ophiophagus Hannah;*2.5%). Malabar Pit-Viper (*Trimeresurus malabaricus*), Common Cat Snake (*Boiga trigonata*) and Forsten's Cat snake (*Boiga forsteni;*) which are mildly venomous together contributing less than 1% of the total rescued snake.

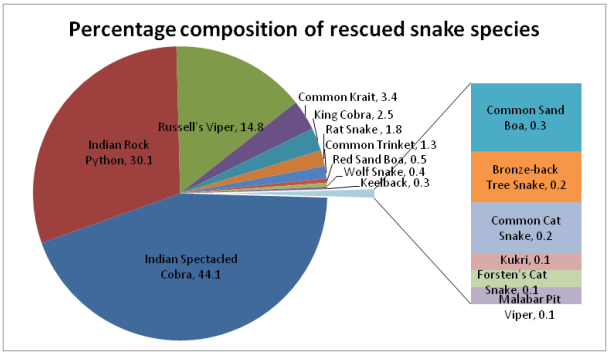

Fig. 1. Percentage composition of rescued snakes from Kannur District (2011 to 2014)

Indian Rock Python (*Python molurus;* 30.1%) was the commonly rescued non-venomous snake in Kannur. Other non-venomous snakes were Rat snake (*Ptyas mucosa*; 1.8%), Common Trinket snake (*Coelognathus helena;* 1.3%), Wolf snake (*Lycodon aulicus;* 0.4%), Common Kukri (*Oligodon arnensis;* 0.1%), Keelbacks (mainly *Xenochrophis piscator* 0.3%) Common sand boa (*Eryx conicus;* 0.3%) and Red sand boa (*Eryx johnii;* 0.5%). Percentage composition of rescued snakes from 2011 Oct to 2014 Oct is given in figure 1.

Monthly variation in venomous snakes rescued in Kannur district (Fig. 2) had shown significant variations. Indian Spectacled cobra was highest in number during pre-monsoon – summer time (Feb to Jun) which coincides with the time of reproduction (April- July). Russell' Vipers are mostly nocturnal but in cooler weather it's active during daytime hence most of the snakes were encountered during Nov- Jan and also high encounter of juvenile vipers were found during April to June where they give birth to young ones. Kraits are nocturnal snakes mainly encountered during cooler months (Oct- Jan) of the year. The World's largest venomous snake, King Cobra (36 no.) were rescued in Alakode and Aralam areas of Kannur which are adjacent to Semi-evergreen forest types highly in the months of Feb - April. Pythons were encountered during post monsoon (North-East monsoon) season and peak activity around human beings was seen during Oct-Jan months. Successful awareness had increased the snake rescue calls in the district; there were 40% increases in rescue calls in 2013 compared to 2012.

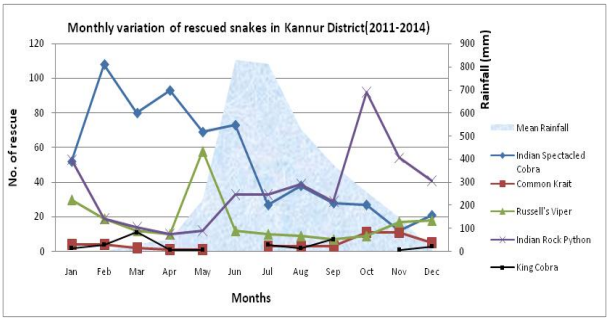

Fig. 2. Monthly variation in top five snakes rescued in Kannur district.

4. DISCUSSION

A total of 1427 snakes were rescued in Kannur district of which 65% were venomous snakes. Higher percentage of venomous snakes may be due to either high population status of these snakes in the area or due to chance that most of the people recognizes venomous snakes and prefer to call for rescue when encountered only venomous. They either avoid non-venomous snakes or kill them. This may be the reason why Rat snakes are recorded

less (1.8% of the total rescue). Top seven species rescued are larger in size, usually terrestrial and shows wide activity time. None of them is exclusively nocturnal. This might be another reason that people don't ignore them when found. Snakes which are recognized for their venom or some myths are likely to be more in rescues. People feel unable to deal with them if they are clearly dangerous or known for some myths for eg Cobra is known for myths and bites. So people don't take much chances and call for rescues even if it is staying far away from the house. Also, Large snakes are cause of fear so even if they are not inside human house people call for their rescues. This includes Python, King Cobra, Cobra and Rat snake etc. Hence this data cannot represent exact population status of snakes in the District but it can be taken as encounter rate of snakes and details such as diversity of snakes, abundance and monthly activity pattern of snakes can be assessed.

Seasonality of snakes rescued reflects the activity pattern of snakes in the district. This information can lead to management and conservational plans to prevent human- snake conflicts. Cobra was found to be common venomous snake encountered in the district. Similar rescue data from Shimoga, Karnataka (Jadageesh *et al.,* 2015) and Amaravati District, Maharashtra (Nande and Deshmukh, 2007) showed a high number of rescued cobras. Cobras were found in more numbers because of the occurrence of their prey species like rat and mice around human habitation. They are solitary, nocturnal and diurnal, but active mainly at dusks and dawns (Khan, 2008; Daniel, 2002). More numbers of rescues were encountered during the summer season. Minimizing rodent population and proper waste management can lead to decrease number of these snakes in the compound. Russell's viper accounts to 14.8% of the total rescue with 211 individual rescues in the district. These snakes are found mostly in open, grassy/ bushy areas, small jungles, plantation and farmland and known to avoid marshes, swamps and rain forest (Mallow, *et al.,* 2003). It's a nocturnal forager but in cooler conditions it becomes active during the day (Mallow *et al.,* 2003). High numbers of viper were encountered during colder months (Nov- Feb) in the district. Russell's viper have a gestation period of 6 months and produce young during May to July; (Daniels, 2002; Mallow, 2003) hence more Juveniles of Russell's viper were found in the month of May also more bites were recorded in these months (Roshnath unpublished data). Precautions are to be taken during this period while walking out in leaf litters and night hours. Common kraits were rescued less (3.4%) in the district and more rescues were encountered during the cooler months (October – January) and mostly were found inside houses. Flower pots and other material should be kept away from houses to minimize hideout places for snakes. Care should be taken during working in fields, clearing vegetation or firewood collection. No plants should be planted near to the window and trees branches reaching out to the house should be cut so that snakes won't reach the house

Most of the King Cobra rescued from Kannur came from Aralam and Alakkode regions of Kannur where there is thick forest vegetation nearby. And Most of the king cobras rescued were in newly molted stage (*Pers comm*. from Riyas Mangad). After molting for every snake, there is a high demand of energy so they forage in search for preys. *Ophiophagus hannah* is a diurnal predator and feed mainly on snakes and lizards of the genus *Varanus*. (Cox, 1991; Daniel, 1983). Rat snakes are found near human habitations seeking rodent preys and the King Cobras are after Rat snakes. Eventually, King cobras are encountered near human habitation which causes the conflict. Usually, people seeing King cobra passes the information to Forest Officials and proper actions are taken from the side of the Forest Department. The number of King Cobra rescued (36no) suggests a good population of the species in the District. Nests are usually made in cooler habitat like bamboo thickets inside forest without Human disturbance (Cox, 1991) In India the nesting season for King Cobra extends from April to July (Daniel, 1983) and low number of rescue were observed in these months as these snakes might be in Nesting stage.

A total of 429 individuals were rescued during the period 2011-2014 indicating a high number of pythons in the district. Pythons inhabit a wide range of habitats including wetlands, open forest, scrublands, harsh desert, rainforests, woodlands, grassy marshes, river valleys, mangroves, rocky slopes, and savanna (Murphy and Henderson, 1997; Whitaker 1987) and have a widespread distribution in most parts of India (Whitaker, 1993; Bhupathy, 1995). More activity of python was observed during post-monsoon rains in the district and more juveniles were rescued in the season (pers. Comm. from Riyas M.). Germination of seeds and sprouting of vegetation during monsoon might be used by python hatchlings for shelter during dispersal (Vijayan, 1991). Pet animals and birds, hen cages, and rodents attract pythons near human habitations. People staying near water sources are more to be bothered about pythons

during rain. *Python molurus,* Indian rock python is listed in Schedule I of the Indian Wildlife Protection Act 1972, then too about four cases of python poaching for meat and fat was reported in Kannur in 2015 (Pers comm.. Thaliparamb Forester).

The rescued snakes are translocated to the safe and natural environment even though translocation of snakes to its natural habitat is always a question of debate in towns. Translocation is just an immediate mitigation measure to get rid of snakes however other factors such as survival of translocated individual, territoriality, competition pressure etc are not in concern. Better education and awareness to the public should be given for not to capture away some species of snakes those are living outside the house. A decent small distance relocation/shift will help both the community and snakes safe. Most of the snakes are found in human inhabited areas were the prey availability (rats) is more. Proper waste management and rodent control can prevent the snake entering in the house to an extent. Study of sensitivity of herpetofauna towards urban habitat is essential for long-term conservation measures and risk assessment (Raxworthy and Nussbaum, 2000). Increase knowledge among public regarding common snakes would help in conservation of the snakes in the region. Awareness classes are to be taken in areas where there are high populations of snakes (mainly rural areas).

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BIBLIOMETRIC MAPPING OF "INDIAN JOURNAL OF PEDIATRICS" 2007-2016

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ABSTRACT

The aim of this paper is a special reference to the research productivity of a journal called "Indian Journal of Pediatrics". The source and citation data have been downloaded from the Web of Science (WoS) database of Thomson–Reuters. Totally 2980 records were published by this journal. This study made an effort to measure the year wise distribution of publications, document wise distribution of publications, institution wise distribution of publications and the country wise distribution of publications. The result resolves the number of total global citation score for above mentioned ten year records. The mapping work has done by using the software *VOSviewer* for analysing the records of this journal. In further the Histograph analysis made by *Histcite* software.

Keywords: Pediatrics, Scientometric Analysis, Histcite, Research Productivity.

1. INTRODUCTION

Indian Journal of Pediatrics (IJP) is an official publication of Dr. K.C. Chaudhuri Foundation. The Journal is a peer-reviewed publication and it is published on a monthly basis clinical and basic research of all aspects of Pediatrics. This journal provides the scientific merit and represents an important of advance in knowledge. The Journal publishes original articles, review articles, case reports which provide new information. This study analyses and explained by the way of bibliometric mapping. Bibliometric is a method to measure or assess the output and impact of an individual's research, a research group or institution or a journal. Mapping is a general method that can be used to help any individual or group to describe their ideas about some topics in a pictorial form.

2. OBJECTIVES

The study of four different aspects given as follows:

1. To analyse the year wise distribution of publications.
2. To examine the document wise distribution of publications.
3. To evaluate the Institution wise distribution of publications.
4. To explore the country wise distribution of publications.

3. REVIEW OF LITERATURE

Bibliometric techniques using references made to other documents can be applied to establish statistical models of scholarly communication flow. (Borgman, 1999). Indeed, citation analysis is an important area of library and information science. From the studies of citation analysis, one can learn which scholars from which disciplines cite which articles? Which journals are cited more often? Which disciplines cite the journals of other disciplines? The results of citation analysis are used for many purposes, for example, to determine the impact of specific articles or journals on subsequent research and to document the interdisciplinary applicability of various journals (Desai, 2003; Harter, 1996; http://lac3.glis.ntnu.edu.tw/vj-attachment/2011/07/attach69.pdf). Mapping of science in the second procedure in evaluative bibliometrics, mostly aiming at displaying structural and dynamic aspects of scientific research (Bramm, 1991; Noyons *et al*., 1999). Maps of science have been created with different techniques. The co-citation technique was initiated by Henry Small at the Institute for Scientific Information (ISI) and further developed in the early seventies (Small, 1973; http://search.proquest.com/ope).

Bibliometric is the application of mathematical and statistical methods to publications. Satyanarayana (2014) TOURISMOS: A Bibliometric Study. In this referred study used to assess scientific research through quantitative studies on research publications. Bibliometric assessments are based on the assumption that most

scientific discoveries and research results are eventually published in international scientific journals where they can be read and cited by other researchers (https://www.omicsgroup; Kumar *et al.,* 1998). In pediatric population, the liver abscesses are associated with immuno compromised state, protein energy malnutrition and low socio economic status. The most common organism responsible for PLA are *Staphylococcus, Streptococci, E coli and Klebsiella. Approximately 65% of liver abscess are found in right lobe and are solitary.* The most common symptoms of PLA are pain in upper abdomen, nausea, vomiting loss of appetite, high grade fever and jaundice(Mishra, 2003). There is a huge demand from researchers for the updated version of this scale because changes in inflation rate change the monetary values of the monthly income range scores. Thus, it has become imperative to provide the updated version of the scale in a domain with large circulation to fulfil the needs of currently ongoing research (Darmstadt, 2005). All the packages of care are cost effective compared with single interventions. Universal (99%) coverage of these interventions could avert an estimated 41-72% of neonatal deaths worldwide. At 90% coverage, intrapartum and postnatal packages have similar effects on neonatal mortality-two-fold to three-fold greater than that of antenatal care. (http://www.ncbi.nlm.nih.gov/pubmed/15767001).

Keunen, (2015) co-authored a paper in *Pediatric Research* entitled, "Impact of nutrition on brain development and its neuro protective implications following preterm birth" (doi:10.1038/pr.2014.171), which published in the January 2015 Review Issue focusing on Nutrition and the Microbiome. Sherin U. Devaskar, (2014) annual review issue of *Pediatric Research*, focusing this year on the Basic Mechanisms of Pediatric Disease. Granier, Goulet, and Hoarau, (2013) explore the immunological effects of fermentation products in animal and humans. This Integrated Mechanism Review article covers 55 studies involved in this area of research. As the authors note, a better understanding of fermentation products' action at the gut and mucosal level may contribute to a better knowledge of mucosal immune maturation and to the necessary discussion regarding the use of infant formulae orientated to immune modulation. Carlo Agostoni and Kwang Sik Kim (2015) served as the Guest Editors Pediatric Research 2015 Review Issue on "Nutrition and the Microbiome". In putting together the issue, the guest editors focused on the roles of nutrition and gut flora on infants' and children's health and disease. Early growth spurts may affect the expression of non-communicable disorders, such as type 2 diabetes, high blood pressure, dyslipidemic conditions, and hepatic statuses. Aleixandre *et al.* (2013) - Mapping scientific research on wine and health. Institutions in the main network of collaboration between centers were primarily located in France, Italy, and the United State.

4. METHODOLOGY

The data collected from the Web of Science [WoS] [Hist Cite software] which is functioning as the platform in providing data. This database is from Thomson Reuters ie. [Thomson Reuters was created by the Thomson Corporation's purchase of British-based Reuters Group on 17 April 2008, and is majority owned by The Woodbridge Company, a holding company for the Thomson family. Thomson Reuters was ranked as Canada's "leading corporate brand" in 2010 Inter brand Best Canadian Brands ranking.] This paper's study period is [2007-2016].

5. DATA ANALYSIS AND INTERPRETATION

Table 1. Year wise distribution of publications

S. No	Publication Year	Records	%	TLCS	TGCS
1	2007	234	7.9	81	1560
2	2008	282	9.5	70	1008
3	2009	272	9.1	45	907
4	2010	292	9.8	68	836
5	2011	243	8.2	91	787
6	2012	291	9.8	128	675
7	2013	317	10.6	142	563
8	2014	457	15.2	149	415
9	2015	288	9.7	79	184
10	2016	304	10.2	57	85
	Total	2980			

The table 1 clearly shows that 2980 publications were published at global level during 2007 to 2016. The highest publication is 457 in 2014 with 415 Global Citation Scores followed by 317(10.6%) publications in the year of 2013 with 563 Global Citation Scores and 304 (10.2%) publications in the year 2016 with 85 Global Citations. It shows that if the publication is comparatively less even then the score of Global Citation can get the higher values.

It is found from the table 2 and the figure 1 showing that 1845 articles with 61.9% is the highest number in the records have been published when compare with the other documents. The remaining documents are the Letter 733 - 24.6%, Editorial

Material 236-7.9%, Review 130-4.4%, Correction 27-0.9%, Article Proceeding Paper 7-0.2%.

Table 2. Document wise distribution of publication

S. No	Document Type	Records	%	TLCS	TGCS
1	Article	1845	61.9	734	6252
2	Letter	733	24.6	70	435
3	Editorial	236	7.9	18	95
4	Review	130	4.4	86	191
5	Correction	27	0.9	0	0
6	Article;	7	0.2	2	38
7	Biographical-	1	0	0	0
8	Reprint	1	0	0	9
	Total	2980	-	910	7020

This table-3 clearly says that the Institution wise research productivity has given the list of institution is 20 numbers from the database of web of science [WoS]. These 20 institutions' total contribution of records is 1299. From this report the highest number of research publication 357 is given by All India Inst Med Sci. with local citation score-119 and the global citation score is-968 followed by Postgrad Inst Med Educ and Res-142 research publications with local citation score-45 and global citation score is-434.

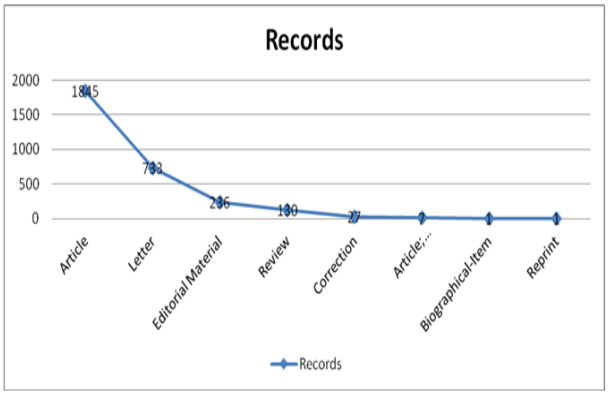


Fig. 1. Document wise distribution of publication

Table 3. Institution wise distribution of publication

S.No	Institution	Recs	Percent	TLCS	TGCS
1	All India Institute of Medical Science	357	12	119	968
2	Postgraduate Institute Medical Education and Research	142	4.8	45	434
3	Christian Medical College and Hospital	103	3.5	99	214
4	Lady Hardinge Medical College and Hospital	82	2.8	37	211
5	Maulana Azad Medical College	81	2.7	25	191
6	Thiruvananthapuram Medical College	51	1.7	59	72
7	Govt Medical College	50	1.7	34	182
8	JIPMER	46	1.5	16	125
9	Banaras Hindu University	44	1.5	6	112
10	Post Graduate Institute of Medical Education and Research	43	1.4	23	87
11	Associated Kalawati Saran Childrens Hospital	39	1.3	9	59
12	Sir Ganga Ram Hospital	36	1.2	6	67
13	Kalawati Saran Childrens Hospital	34	1.1	21	129
14	University College of Medical Science	30	1	9	155
15	Kanchi Kamakoti CHILDS Trust Hospital	29	1	10	50
16	King Edward Memorial Hospital	28	0.9	19	108
17	Seth GS Medical College	27	0.9	16	107
18	PGIMER	26	0.9	4	50
19	Sanjay Gandhi Post graduate Institute Medical Science	26	0.9	8	55
20	Govt Medical College and Hospital	25	0.8	11	52
	Total	1299		576	3428

Table 4. The Country wise distribution of publication

S. No	Country	Recs	%	TLCS	TGCS
1	India	2249	75.5	763	5270
2	USA	161	5.4	57	565
3	Turkey	148	5	27	298
4	UK	83	2.8	18	180
5	Peoples R	74	2.5	10	132
6	Iran	70	2.3	16	267
7	Canada	45	1.5	20	91
8	Unknown	29	1	0	41
9	Egypt	25	0.8	3	84
10	Australia	22	0.7	10	73
11	Italy	22	0.7	6	29
12	Thailand	19	0.6	2	5
13	Japan	18	0.6	4	32
14	South	14	0.5	6	23
15	Saudi	12	0.4	1	32
16	Nepal	11	0.4	7	50
17	Nigeria	11	0.4	0	38
18	Pakistan	11	0.4	1	41
19	Spain	11	0.4	3	16
20	Brazil	10	0.3	0	15
	Total	3045		954	7282

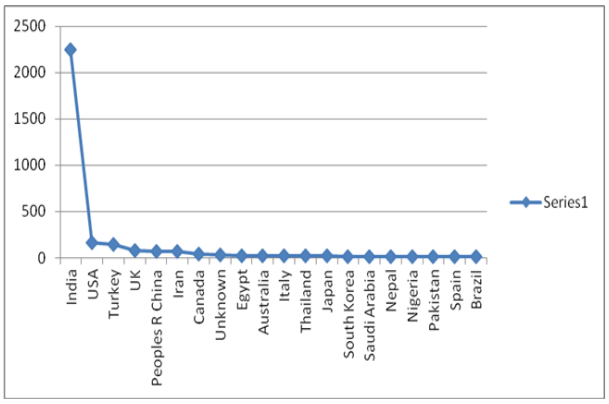


Fig. 2. The Country wise distribution of publication

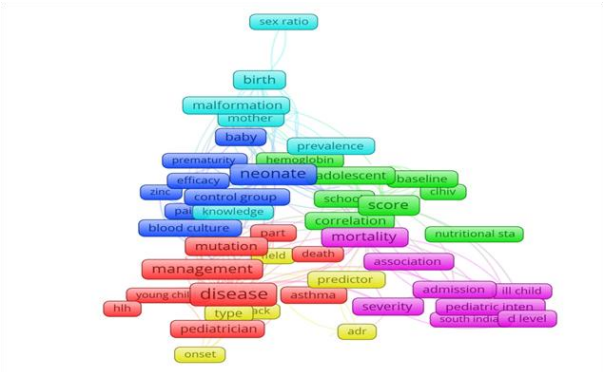
Here the table 4 and the figure 2 explores the country wise distribution totally 69 countries were covered. The maximum publications contributed by India with 2249 records -75.5% followed by USA 161 records with 5.4%, Turkey 148-5%, UK 83-2.8% etc., according to the IJP the top in Global Citation Score is India with 2249 publications local citation score 763 and global citation score is 5270.

5.1 Word frequency

Table 5. The most used keywords in this article.

S.No	Word	Recs	TLCS	TGCS
1	NEONATE	479	188	1282
2	MUTATION	257	53	436
3	MORTALITY	213	133	602
4	PEDIATRICIAN	174	61	389
5	DISEASE	171	48	340
6	ASTHMA	162	52	430
7	PREVALENCE	144	76	506
8	BIRTH	137	33	183
9	SCORE	130	52	398
10	MANAGEMENT	125	48	292

Fig. 3 showing the top 10 most used words by IJP, and it expresses the mapping link between those words by the VOSviewer. This is clearly states that the list of keywords with their records of TLGS and TGCS. This study has given the result as the word neonate used in 479 records and the word mutation used in 257 then mortality is in 213 records, paediatrician word has been used in 174records, disease in 171 records, asthma in 162 records, prevalence in 144 records, birth 137 records, score in 130 records management in 125 records. The TLGS and TGCS are 188 and 1282, 53 and 436, 133 and 602, 61 and 389, 48 and 340, 52 and 430, 76 and 506, 33 and 183, 52 and 398, 48 and 292 respectively.



5.2 Histograph of IJP

Using the software HistCite, the histograph has been developed for the period of 2007 – 2016. This histograph showing the links of records published with the respective years. The below table shows the top 30 authors of IJP during 2007-2016 based on their local citation score and global citation score. In this Histograph the LCS gives 122 scores and GCS gives 422 scores

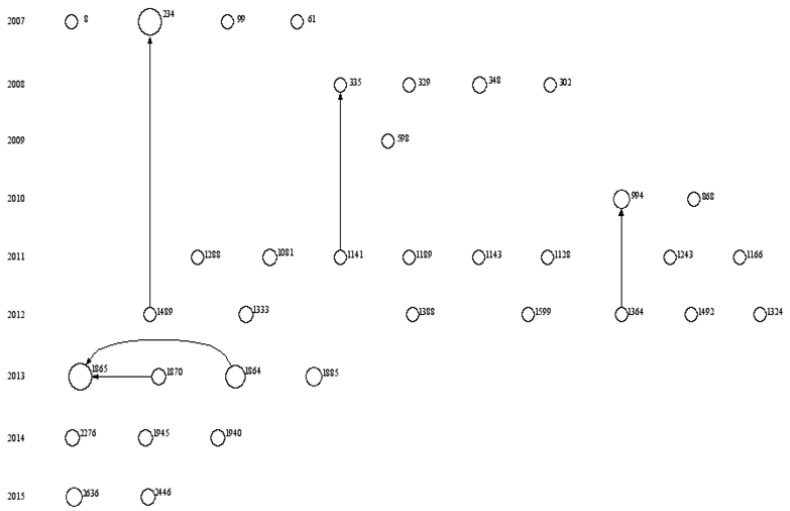


Fig. 4. Histograph of IJP

Nodes: 30, Links: 3

LCS, top 30; Min: 3, Max: 10 (LCS scaled)

S.No	Recs.	Author	LCS	GCS
1	8	Lahariya C, 2007, INDIAN J PEDIATR, V74, P61	3	9
2	61	Medhi GK, 2007, INDIAN J PEDIATR, V74, P343	3	8
3	99	Nagapoornima P, 2007, INDIAN J PEDIATR, V74, P545	3	20
4	234	Kumar N, 2007, INDIAN J PEDIATR, V74, P1131	10	135
5	302	Kohli U, 2008, INDIAN J PEDIATR, V75, P82	3	3
6	329	Chandra J, 2008, INDIAN J PEDIATR, V75, P229	3	12
7	335	Sankar MJ, 2008, INDIAN J PEDIATR, V75, P261	3	31
8	348	Yeolekar LR, 2008, INDIAN J PEDIATR, V75, P341	4	21
9	598	Balan R, 2009, INDIAN J PEDIATR, V76, P469	3	12
10	868	Agnihotri K, 2010, INDIAN J PEDIATR, V77, P381	3	11
11	994	Kaur G, 2010, INDIAN J PEDIATR, V77, P969	5	21
12	1081	Bansal A, 2011, INDIAN J PEDIATR, V78, P33	4	16
13	1128	Mukherjee A, 2011, INDIAN J PEDIATR, V78, P328	3	9
14	1130	Amdekar YK, 2011, INDIAN J PEDIATR, V78, P340	3	4
15	1141	Zakariya BP, 2011, INDIAN J PEDIATR, V78, P413	3	15
16	1143	Bhattacharya S, 2011, INDIAN J PEDIATR, V78, P423	3	6
17	1166	Sivanandan S, 2011, INDIAN J PEDIATR, V78, P576	3	6
18	1189	Krishnan L, 2011, INDIAN J PEDIATR, V78, P743	3	7
19	1243	Rana N, 2011, INDIAN J PEDIATR, V78, P1073	3	8
20	1333	Nair MKC, 2012, INDIAN J PEDIATR, V79, PS60	4	6
21	1336	Nair MKC, 2012, INDIAN J PEDIATR, V79, PS74	4	8
22	1864	Russell PSS, 2013, INDIAN J PEDIATR, V80, PS132	7	7
23	1865	Russell PSS, 2013, INDIAN J PEDIATR, V80, PS139	9	9
24	1870	Russell PSS, 2013, INDIAN J PEDIATR, V80, PS165	4	5
25	1885	Nair MKC, 2013, INDIAN J PEDIATR, V80, PS248	5	5
26	1940	Bansal D, 2014, INDIAN J PEDIATR, V81, P42	4	4
27	1945	Menon PSN, 2014, INDIAN J PEDIATR, V81, P76	4	7
28	2276	Balasubramanian P, 2014, INDIAN J PEDIATR, V81, P1182	4	4
29	2446	Bal D, 2015, INDIAN J PEDIATR, V82, P253	4	5
30	2636	Prasad S, 2015, INDIAN J PEDIATR, V82, P991	5	8

6. CONCLUSION

From this study it is evident that the number of papers published in IJP during 2007 to 2016 is progressively increasing. Most prolific institution is All India Institute of Med Sci. with 357 research articles the local citation score is 119 and the global citation score is 968, followed by Postgrad Inst. Med Educ and Rec. with 142 articles, having local citation score of 45 and global citation score is 434. The list of top 10 country-wise contribution has given in the form of "Rankings" as follows: India, USA, Turkey, UK, China, Iran, Canada, Egypt and Australia. In which India gives the most contribution with 2249 papers.

Based on the analysis totally 1845 research articles are published with the percentage of 61.9. When compare with other documents this is the highest score of research records which is published in this journal. The remaining documents are the Letter 733 records with 24.6%, Editorial Material 236 records with 7.9%, Review 130 records with 4.4%, Correction 27 records with 0.9% and Article Proceeding Paper 7 records with 0.2%.

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