

# **Environmental Wellness**



- Dr. Gargi Rana
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# ENVIRONMENTAL WELLNESS

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## *Preface*

Mahatma Gandhi is quoted as saying, “Earth provides enough to satisfy every man’s needs, but not every man’s greed.” What was Gandhi trying to convey with that statement? Maybe, the Earth does not have limitless resources for human consumption and we as humans impact the health of the planet by the choices we make. All humans live on one planet, planet Earth. Some call Earth “Mother Earth” because Earth nurtures life just like a mother. Human societies throughout history have symbols and depictions of Earth as a nurturer since every species on Earth depends on the resources of the planet for existence. Environmental wellness is having good health by occupying pleasant, stimulating environments that support well-being. It promotes interaction with nature and also creates an enjoyable personal environment (both in and out of your workspace). Everyone can have a strong environmental consciousness simply by raising their awareness and incorporating features that help to make their setting more agreeable to them. The core principle of environmental wellness is respect—respect for all nature and all species living in it. When you become environmentally aware, you will be able to realize how your daily habits affect your home life as well as your work life. Improving environmental wellness is simple and results in a more balanced lifestyle. The book is a perfect example of the same venture with the aim of making each reader environment wellness aware and open horizons of research for future endeavours.

*Dt. Alka Vyas*

## ***About the Book***

Environmental Health is being challenged globally by a number of factors. The fast-paced development has led to several problems that are interrelated and variable, ill-defined, incomplete, challenging and difficult to resolve. Climate change, deforestation, urbanization, loss of biodiversity, STDs, zoonotic illnesses, and other concerns are examples of various factors when it comes to current global health emergencies. These issues are among the continuing challenges in global health because they are complicated, multidimensional, and significantly influenced by social, economic, and political variables. The 21st century faces unprecedented environmental changes, from climate change and urbanization to deforestation, biodiversity, loss of natural resources and habitat. Accelerated economic growth with high consumption level in developed countries and aspirations of developing countries to reach matching levels of growth are continuing to damage our planet. As Earth's ecosystems are disrupted, we face the loss of ecosystem services and even the spread of zoonotic disease, COVID-19 is an example to it. Developing nations like India face even bigger challenge as India is one of the fastest growing economies of the world and will continue its rapid urbanisation and economic development in the coming decades. Unfortunately, this growth is at the cost of degrading environment health in the form of rising consumption and demand for energy, increasing greenhouse gas emissions, and constraints on critical natural resources such as land, water and biodiversity harboured by them.

Every problem has a solution and an old adage says "When there is a Will there is a Way". This book not only discusses the reasons and effects of the environmental damage but also about the way out for a better and healthy environment and Environment Wellness. A collective effort, cooperation and commitment from all sectors of society needs to be thoroughly comprehend for Environmental Wellness.

***Dr. Gargi Rana***

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## Chapter 1

# ACUTE TOXICITY AND BEHAVIORAL ALTERATIONS IN FRESHWATER CATFISH *CLARIAS BATRACHUS* EXPOSED TO SYNTHETIC PESTICIDE NUVAN

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### ABSTRACT

Nowadays pesticides are much overused in the environment by the human beings for agricultural purposes despite the fact that they are toxic and hazardous to our health and environment. A lot of studies have been done to investigate that the use of pesticides is futile and apparently does more harm than benefit in the long run. When these toxic pesticides reaches in aquatic environment then impair to ability of organisms to compete and survive. Contamination of the aquatic environment may be deterrent to aquatic food chain leading to human. Fishes are among best food source on our planet. The cat fishes and other fishes are second most important group with regard to their commercial resolution and generate a numerous commercial valuable by-products. To know the impact of synthetic pesticides in the present investigation, *Clarias batrachus* fish, which are air breathing fish in nature, were exposed to different test concentrations (1 ml, 5ml, 10ml and 15ml) with 20 L of water of an organophosphorus pesticide, nuvan. Fishes were exposed to nuvan at 24, 48, 72, and 96 hours to determine LC<sub>50</sub> value. The mortality data was analyses by Finney's Probit Analysis method and LC<sub>50</sub> value was found to be 0.274 ml/L for *Clarias batrachus*. The present work was undertaken to assess the acute toxicity level of nuvan on *Clarias batrachus* (Linn.). Behavioral alterations are the most sensitive indication of prospective harmful effects.

*Keywords: Toxic effect, Nuvan, Clarias batrachus, LC<sub>50</sub>, Behavioural alterations*

### 1- Introduction

Pesticides are one of the groups of toxic compound linked to human beings uses that have a profound impact on aquatic livings and water quality. Water is one of the main source by which



pesticides are passage from application site to the environment. Water pollution is intended as one of the main problematic concern of this century resulting from the addition of several pollutants in water systems via different ways and they alter natural qualities of water and also affected our environment. The contamination of environment with toxic pesticides has become a source of issue not only because their threats to aquatic livings but also due to community health implications of such toxicants. There are 234 types of pesticides which used in India among them 24 types of pesticides are used widely and another 28 types of them have been banned in India and also in other countries due to their severe toxicity towards the non targeted organisms. The environmental fluctuations such as temperature, dissolved oxygen and pH play major role to enhance pesticide toxicity in the presence of leftover molecules. The enormous use of pesticides in agriculture industries, poses serious danger, both to the social health, fisheries and other aquatic livings. Aquatic animals and aquatic resources are most valuable natural assets. Aquatic animals give greater productivity and protein yield as compared to the agriculture or animal husbandry and have low energy expenditure for food production. Sea food industry delivers jobs for commercial fishers, wholesaler and retailers (Lakhani, 2015).

More than 1000 pesticides recently used in most of the countries unintentionally reach the aquatic ecosystems through two ways firstly the surface runoff of pesticides used in agriculture and forestry and secondly from rainfall, accidental spills, accidental spraying and continuous release from industrial wastages. Besides that pesticides also used to control unwanted aquatic livings, such as mosquitoes, midges, black flies, lampreys, some imported fishes, pond weed, water milfoil, and water hyacinth (Rockets and Rusty, 2007). There are different types of pesticides but all of them organophosphorus pesticides world widely used in agricultural industry to prevent the disease causing agents like insects, pests, parasites etc. due to their lesser persistence in the environment. Among the various group of pesticides, nuvan an organophosphate compound, is generally used against a wide range of pests in agricultural industries, farm animals and man, and also as an anthelmintic. Nuvan also known as Dichlorvos (2,2-dichlorovinyl dimethyl phosphate), has introduced whole world concern as it induces different significant changes in fish biology like behavioural change, alteration in biochemical parameters, neurotoxicity, bioaccumulation in tissues, histopathological changes, undesired developmental changes, chromosomal changes etc. are a few due to dichlorvos toxicity. The biological activity of synthetic pesticide nuvan directly inhibits acetyl cholinesterase (AChE) enzyme activity (Rao *et al.*, 2005) in fish. Different chemicals as well as pesticides belonging from various groups are available in the market but out of them synthetic pesticide nuvan was selected for present work because it is generally used against a great range of pests, insects and mites in farm animals and man, agricultural industries, horticulture and also as an anthelmintic. Fish *Clarias batrachus* chosen as experimental animal because it is the most valuable vertebrate as an edible fish which play an important role in human food chain.

The freshwater catfish *Clarias batrachus* have great nutritional, medicinal, industrial, economic, aesthetic and religious value. Freshwater catfish, *Clarias batrachus* normally found in muddy ponds, swamps and rivers where high concentration of different substances occurs which make water too much dense for the living ones. In the tropical aquatic ecosystems the enormous use of synthetic pesticides and other toxins, fish population reduction would have serious implications in ecosystem yield which could jeopardize freshwater tropical fisheries. However, the furious use of these toxic pollutants in agriculture, horticulture and public operations has altered the ecological balance of various non target organisms like fishes (Todd and Leeuwen, 2000). Unmanaged spraying and improper handling of the synthetic pesticides may cause high risk of the social health hazards. Aquatic ecosystems are the preeminent descend for agricultural residues as well industrial toxicants and it has become a global environmental problem nowadays (Bag, 2000; Gupta, 2004). In general terms, the adverse effects of synthetic pesticides can be directly to their accumulation and persistence in the environment, as well as with the humans and animals body tissues. The aim of this paper work is to highlight the toxicity of synthetic pesticide nuvan on aquatic animals specially fishes as to save the aquatic environment and bio diversity so as to reduce the poisonous effects on human beings and other aquatic animals as well as to conserve the economy of nation which is significant for development of country.

### **Aquatic Toxicology**

Pesticides poisonings of fish, people, livestock and wildlife have occurred when regular care was not taken. Improper use of pesticides can lead to decrease control of the target, environmental damage, impairment of non-target plants and animals and may destroy the natural balance in ecosystems. The capacity of synthetic pesticide to harm fish and aquatic animals is greatly a function of its dose rate, toxicity, exposure time and persistence in the environment. Toxicity of the pesticide means to how poisonous it is. A short exposure to some poisonous pesticides may have low effect on fish, whereas long term exposure of poisonous synthetic pesticide may cause injurious to them. The dose rate refers to the amount of pesticide to which an exposed animal is subjected (dermally, orally, or through inhalation). A lethal dose is the quantity of pesticide mandatory to cause death. Not to all animals of a species die at the similar dose (few are more liberal than others), a standard toxicity dose assessment, called a lethal concentration 50 or LC<sub>50</sub>, is used. This is a pesticide concentration that kills 50% of a model population of animals within a limited period of time, normally 24 to 96 hours, (Helfrich, 2009).

## **2 - Materials and Methods –**

### **I - Experimental fish and synthetic pesticide –**

Various studies have been conducted in analyzing the toxicity of pesticide to the aquatic ecosystem especially fishes. The experimental catfish *Clarias batrachus* (normal 20 - 25 cm length and weight 60 - 120 g) were obtained from a local fish supplier. Experimental specimens were gathered to the departmental laboratory of zoology and were retained in glass aquaria measuring 75cm x 37cm x 37cm. These test fishes were carefully examined and before stocking treated for one minute with 2% KMnO<sub>4</sub> solution to assassinate any dermal infection. Prior to experimentation test animals acclimatized for two weeks. The experimental fishes were habitually fed with marketable food twice a day at a rate of 2.5% body weight and drain off uneaten feed and fecal matter daily. Commercial manufactures of synthetic pesticides are only use in the agricultural fields so commercial level formulations of pesticides were used in this research. Nuvan (Dichlorvos 76% EC) is an organophosphorus pesticide used in this experiment which is manufactured by insecticides (India) limited.

### **II -Acute toxicity bioassay and determination of sub lethal concentration of Nuvan –**

The experimental fishes *Clarias batrachus* were divided in to four groups (A, B, C, and D) in four aquaria to analyze the lethal concentration of nuvan. Each glass aquarium contained 20 L of water and ten fishes in each group. The test fishes were starved for 24 h before the experimentation. The lethal concentration of nuvan noted as the LC<sub>50</sub> at which 50% mortality of model fishes take place. To observe the mortality of *Clarias batrachus* fishes, test was done using four concentrations (1, 5, 10 and 15 ml) of nuvan. These four concentrations were chosen on basis of previous research observations. The test data were collected and used to assess median lethal concentrations (LC<sub>50</sub>) value. Synchronously, behavior alterations of the fish were marked and reported during the exposure period (24h, 48h, 72h and 96h).

## **3 - Results**

The aim of this research work was to investigate the value of lethal concentration of synthetic pesticide nuvan and behavioral alterations after 24, 48, 72 and 96 hrs for freshwater catfish *Clarias batrachus*. Impact of nuvan on ethological changes in activity, swimming rate, fin and operculum movement and body movement pattern till death of model fish *Clarias batrachus* exposed to various lethal concentration of nuvan were reported at 24, 48, 72 and 96 hours (Rand, 1985). To prevent from water fouling, as soon as possible separated the dead fishes (if any) from aquaria.

## **I - Behavioral manifestation:**

The fish indicated normal behavior such as active swimming, well-coordinated with active movements, static equilibrium, free gulping of air at the surface water, normal gill movement, horizontal hanging in the water with real body color and no mortality rates were recorded in the control group. During the exposure of synthetic pesticide nuvan for different time periods (24, 48, 72 and 96 hours), at the lower concentration of toxicant i.e., 1 ml/20L the fish showed normal behavioral responses and less mortality was found but at higher concentration i.e., 5 ml/20L and 10 ml/20L, numerous behavioral changes were like fishes mostly coming to the surface of water, tried to jump out of the water, erratic and darting swimming movements, loss of equilibrium, being lethargic and sluggish, rapid gill movement, vertical hanging, fading of their body colour, increased opercular movements, excess mucus secretion over the whole body and restlessness. Finally fish stays motionless at 15 ml/20L concentration toxicant and open their mouth prior to death in the bottom of the aquarium throughout the test tenures that caused 100% mortality in the test group when compared to the control groups for 24, 48, 72 and 96 h respectively.

## **II - Analysis of acute toxicity –**

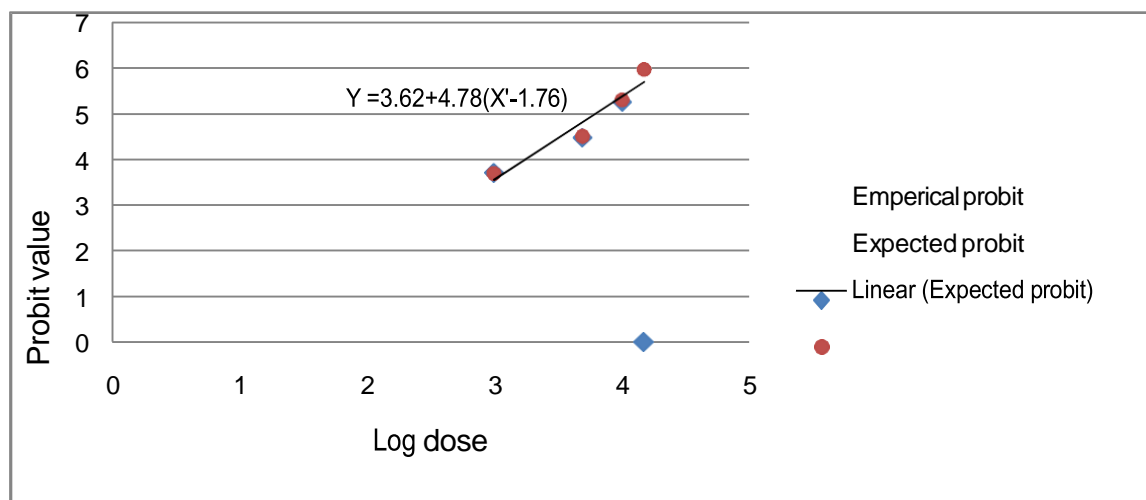
The analysis of acute toxicity is a short term exposure to model fishes under the laboratory condition. The survival numbers of test fishes *Clarias batrachus* were noted for each concentration (1, 5, 10, 15 ml) after 24 hrs, 48 hrs, 72 hrs and 96 hrs. The lowest concentration was 1ml /20L at which 90% test fishes survived at 96 hours while the highest concentration of nuvan was 15 ml /20L at which all fishes died within 96 hours of exposure. The concentration of nuvan at which 50% of experimental fishes died was declared as LC<sub>50</sub> value. After 96 hours of exposure the mortality percentage was recorded (Table 1). The experimental data were analyzed using the Probit Analysis Statistical Method of Finney (1971) (Table- 2). The percentage of fish mortality was recorded and plotted the graph between the concentration of nuvan in water and mortality percentage. On the basis of two variables (log-dose and empirical probit) regression line was plotted on the graph paper to detect the expected probit which is necessary for LC<sub>50</sub> determination (Graph I).

**Table 1** – Survival number and percentage mortality of *Clarias batrachus* after 96 hours of treatment with different concentration of synthetic pesticide Nuvan

Group	Concentration (ml/20L)	No. of fishes	Exposure time in hours				No. of fishes died	No of fishes survive d	Percentage mortality
			24 h	48h	72 h	96 h			
A	1	10	1	0	0	0	1	9	10%
B	5	10	2	1	0	0	3	7	30%
C	10	10	2	2	1	1	6	4	60%
D	15	10	3	3	2	2	10	0	100%

**Table 2** -Toxicity evaluation of Nuvan to *Clarias batrachus* specifying fiducial limits and LC<sub>50</sub>

Experimental fish	Test compound	Regression Equation	Variance	Fiducial limits	Mean of F. limits (M)	LC <sub>50</sub>
<i>Clarias batrachus</i>	Nuvan (76%) (DDVP)	$Y=3.62+4.78(X'-1.76)$	0.017	3.76332(+) 3.69668(-)	3.73	5.4869 ml/20L (or) 0.274 ml/L



Graph (I)- Deterination of LC50 log-dose probit regression analysis due to Nuvan exposure to *Clarias batrachus*

#### 4 - Discussion

Many poisonous synthetic pesticides are not legally permeable for application but still are observed in our environment and ecosystems. Vast variety of pesticides inserted in the aquatic ecosystem and there toxicity is fundamentally identified through single species toxicity testing in laboratory by different researchers. Such type of tests primarily highlights the necessity of techniques that not only indicate the damage caused by toxicants but also indicate the physiological and biochemical impairment. Fishes are the most sensible models for environmental contamination in aquatic ecosystem (Scott and Sloman, 2004; Sindhe *et al.*, 2007). Behavioral responses are the most sensitive signs of potential toxic effects. Different fishes showed numerous behavioral alterations when were treated with different concentrations of toxic pesticides and harmful chemicals. Impact of hazardous pesticides on the behaviour of freshwater catfish *Clarias batrachus* have been studied by many other workers (Trivedi and Saksena, 1999; Tripathi and Verma, 2004; Patnaik and Patra, 2006; Paul *et al.*, 2011; Narra, 2016 and Saha *et al.*, 2021). Different other researchers noted various behavior responses in different fishes (Anita *et al.*, 2010; Marigoudar *et al.*, 2009; Nagaraju *et al.*, 2011).

In the present work during acute toxicity test, the test fishes exhibited several irregular behavioral responses such as swimming much more frequently jumping, abnormal and darting swimming movements, rapid gill movement, increase in opercula movements, vertical hanging, fading of body colour, lethargic and sluggish, mucus secretion in excess amount all over the

body and restlessness (Somaiah *et al.*, 2014). The similar behavioral symptoms were observed in mosquito fish, *Gambusia affinis* due to the sub-lethal exposure to chlorpyrifos (Rao *et al.*, 2005). These behavioral changes might have caused from nervous and respiratory manifestations due to nuvan exposure. Similar findings were noted in guppy fish, *Poecilia reticulata* (Viran *et al.*, 2003; Ylmaz *et al.*, 2004) and in rainbow trout, *Oncorhynchus mykiss* (Ural and Saglam, 2005), when acutely exposed to various concentrations of the synthetic pesticide like nuvan. These behavioral responses can also be declared as symptoms of stress in the model fish. It is declared in the present investigation, the fishes after intoxication with nuvan were similar to those observed in other analysis by peer researchers (Marigoudar *et al.*, 2009; Anita *et al.*, 2010).

In the present inquiry, 96 hrs LC<sub>50</sub> values of nuvan to freshwater catfish *Clarias batrachus* were observed as 0.274 ml/L which is approximately near to the reported LC<sub>50</sub> value by Rani and Gautam (2012). They recorded lethal concentration of Nuvan for the freshwater fish *Channa punctatus* 0.27 ml/L at 24, 48, 72 and 96 h. The comparative hazardous effects of nuvan and chlorpyrifos on the behavior responses and haematology of African catfish (*Clarias gariepinus*) and analyzed LC<sub>50</sub> value due to exposure of nuvan after 96 h as 0.184 ml/L by Ashade *et al.*, (2011) while in *Channa punctatus* at 96 h LC<sub>50</sub> value observed 0.024 ml/L by Kumar (2014); Kumar and Gautam, (2014) and also investigated biochemical changes due to toxicity of nuvan in *Channa punctatus* (Bloch.). Gautam *et al.*, (2014) observed LC<sub>50</sub> value at 96 h as 0.07 ml/l. and hazardous effect of nuvan on blood biochemistry of fish *Clarias batrachus*. Worldwide research reports found effect of pesticides on aquatic organisms (Ahalavat and Hasan, 2018).

In the present experiment LC<sub>50</sub> value after effects of nuvan calculated as 0.274 ml/L for catfish *Clarias batrachus* which is greater than the value reported by many other workers like Verma *et al.*, (1983) noted LC<sub>50</sub> 8.9 mg/L at 96 h in *Clarias batrachus*; Bhat *et al.*, (2012) noted LC<sub>50</sub> value as 42.66ppm in fish *Labeo rohita* after 96 h ; in *Heteropneustes fossilis* LC<sub>50</sub> value after 96 h noted as 6.45 mg/L by Ahmad and Gautam, (2014) due to the exposure of nuvan. Varo` *et al.*, (2008) calculated 96 h LC<sub>50</sub> value 3.17 mg/l. Similarly LC<sub>50</sub> values also recorded as 20 mg/l by Srivastava *et al.*, (2014) in fish *Cirrhinus mrigala* after exposure of nuvan and 9.1ppm by Velmurugan *et al.*, (2009). Tilak and Swarna Kumari (2009) noted that in static system and continuous flow the LC<sub>50</sub> value after 96 hrs were 6.5 mg/L and 7.5 mg/L in *Ctenopharyngodon idella* respectively due to the exposure of organophosphorus pesticide nuvan. While toxic effect of nuvan and its LC<sub>50</sub> values in fish *Clarias gariepinus* (Burchell, 1822) noted as 275.2 µg/L (fingerlings) and 492 µg/L (juveniles) by Omoniyi *et al.*, (2013). Whereas Patar *et al.*, (2015) reported toxicity effects of dichlorvos, malathion and temephos and observed 96 h LC<sub>50</sub> of nuvan 2.35 mg/L.

Many more observers calculated LC<sub>50</sub> values of various pesticides which is used in agricultural purposes and found various differences in their observations. Such type of differences could be due to variance between the active components of the pollutants. Variations in temperature have also more effective to find the toxicity of toxicants. Nowadays it is well

known fact to all the pesticides possess long term risk to higher vertebrates as it accumulates in the tissue of organisms in higher concentration containing the topmost niche of the food chain due to the property of biological magnification (Deka and Mahanta, 2015). Unfortunately, toxic pesticides are being used in an alarming rate or unsafely for the sake of earning an enormous amount from the crop with less labor and effort by the people to pay it again to treat an ailment concluding from pesticide effect.

## 5 – Conclusion

Present experimental work indicates considerable amount of hazardous pesticide pollutants from industry, urbanization and from agricultural industries are reaching in aquatic ecosystems posing great threat to aquatic species especially fishes. Environmental stressors exert unfavorable effects at the organism's level leading to the disturbed physiology of organisms along with growth retardation, tissue damage, tissue bioaccumulation, genotoxicity, reproductive disturbance. Experimental evaluations reveal that pesticides are potent to cause poisonous effects, structural alterations in non target livings like fishes. Therefore combined efforts required in decreasing the use of synthetic pesticides. Poisonous pesticides must be used with serious care, so that the health of humans, other animals and the environment are protected. Disadvantages of synthetic pesticides include their toxicity to humans, beneficial animals and useful plants, and the persistence (long life) of these toxic chemicals in the environment, which causes serious health hazard both to our society and the environment.

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## Chapter 2

### **SUSTAINABLE DEVELOPMENT: NEED FOR A SUSTAINABLE FUTURE**

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#### **ABSTRACT**

In the present scenario, sustainable development is a requirement of the society and environment. Without sustainable development, our coming generation cannot survive for a longer time because the exploitation of natural resources and destruction of natural habitats for economic activity is increasing by leaps and bounds. Therefore, this study highlights the concept of sustainable development and creates awareness among the common people, industrialists, and the government. The 2030 Agenda for Sustainable Development, including the 17 Sustainable Development Goals (SDGs), are global objectives that succeeded the Millennium Development Goals on 1 January 2016. The SDGs will shape national development plans over the next 15 years. From ending poverty and hunger to responding to climate change and sustaining our natural resources, food and agriculture lie at the heart of the 2030 Agenda.

*Keywords- Sustainable Development, Agenda 2030, Economic Growth, Environmental awareness*

A development that is sustainable is one that satisfies current requirements without endangering the capacity of future generations to satisfy their own needs. The 2030 Agenda for Sustainable Development and its Sustainable Development Goals, today's leading global framework for international cooperation, are built on sustainability (SDGs). Global environmental leaders gathered in June 2022 to assess where we have been from and where we are going in order to rekindle support for the UN Decade of Action to achieve the SDGs. These conferences mark important turning points in the governance of sustainable development. However, the work done daily by people, local communities, international organizations, and others serves as their true test.

The SDGs and Agenda 2030's ambitious goals demand action on all fronts; governments, corporations, civil society organizations, and individuals worldwide all have a part to play.

A guiding principle of sustainable development is achieving human development goals while maintaining the capacity of natural systems to supply the natural resources and ecosystem

services that are essential to human economies and society. A state of society where living circumstances and resources are used to meet human needs while maintaining the integrity and stability of the natural system is the desired outcome.

Sustainable development was defined in the 1987 Brundtland Report as "Development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs". As the idea of sustainable development has grown, its emphasis has switched from environmental conservation for present generations to economic development, social development, and environmental protection.

The 1992 Rio de Janeiro Earth Summit launched the Rio Process, which was the first attempt to institutionalize sustainable development. The Sustainable Development Goals (SDGs) were approved by the United Nations General Assembly (UNGA) in 2015, and they were described as being interconnected and indivisible in order to achieve sustainable development on a global scale. Global issues like poverty, inequality, climate change, environmental degradation, peace, and justice are addressed by the 17 goals of the UNGA.

Sustainable development and the normative concept of sustainability are connected. According to UNESCO, sustainability is frequently considered a long-term objective (i.e., a more sustainable world), but sustainable development refers to the various methods and routes taken to get there. There are many ways in which the idea of sustainable development has been questioned. While some believe that development is fundamentally unsustainable and view it as contradictory (or an oxymoron), others are disappointed in the lack of advancement that has been made thus far. The fact that "development" is not uniformly defined contributes to the issue.

## **DEFINITION**

The UN World Commission on Environment and Development published the document, often known as the Brundtland Report, in 1987. The study's definition of "sustainable development" was adopted and is now often used.

A development that is sustainable is one that satisfies current requirements without endangering the capacity of future generations to satisfy their own needs. It incorporates two fundamental ideas: the idea of "needs," especially the basic needs of the world's poor, to whom top priority should be given; and the notion that environmental sustainability is constrained by the state of technology and social organization.

## **DEVELOPMENT OF THE CONCEPT: SUSTAINABILITY**

The concepts of sustainable forest management that were created in Europe throughout the 17th and 18th centuries are the foundation of sustainable development. John Evelyn claimed in his 1662 essay *Sylva* that "sowing and planting of trees ought to be recognized as a national obligation of every landowner, in order to avert the catastrophic over-exploitation of natural

resources" in response to rising awareness of the depletion of lumber resources in England.

Sylviculture economics, a 400-page study on forestry, was written in 1713 by Hans Carl von Carlowitz, a senior mining administrator in the service of Elector Frederick Augustus I of Saxony. Von Carlowitz pioneered the notion of managing woods for sustained output by building on those of Evelyn and French minister Jean-Baptiste Colbert. His contributions, which also had an impact on Georg Ludwig Hartig and Alexander von Humboldt, helped pave the way for the advancement of the science of forestry. This, in turn, influenced individuals like Aldo Leopold, whose land ethic was influential in the development of the environmental movement in the 1960s, and Gifford Pinchot, the first director of the US Forest Service, whose approach to forest management was driven by the idea of wise use of resources.

The growing environmental movement brought attention to the link between economic development and environmental degradation when Rachel Carson's 1962 book *Silent Spring* was published. Kenneth E. Boulding emphasized the necessity for the economic system to adapt to the ecological system with its finite resources in his seminal 1966 essay *The Economics of the Coming Spaceship Earth*. The Garrett Hardin paper from 1968, which popularised the phrase "tragedy of the commons," was another important turning point. A team of scientists led by Dennis and Donella Meadows of the Massachusetts Institute of Technology used the term "sustainable" for the first time in the modern sense in the Club of Rome's seminal report on the *Limits to Growth* in 1972. The authors stated that they were looking for a model output that represented a world system that was sustainable without experiencing an abrupt and uncontrollable collapse and was able to meet the basic material needs of all of its inhabitants. The significant book *A Blueprint for Survival* was also published in that year.

The first hearings on sustainable development were held in 1975 when an MIT research team prepared ten days of hearings on "Growth and Its Implication for the Future" for the US Congress.

The phrase "sustainable development" was first used by the International Union for Conservation of Nature in a world conservation strategy that was published in 1980. This strategy also contained one of the earliest references to sustainable development as a worldwide priority. Two years later, the United Nations World Charter for Nature outlined five conservation tenets that should serve as a guide and standard for all human actions that have an impact on the environment.

The goal of "socially inclusive and environmentally sustainable economic growth" has gained increased attention since the Brundtland Report, moving the notion of sustainable development beyond its original intergenerational framework. A just, sustainable, and peaceful global society for the twenty-first century is outlined in the Earth Charter, which was released in 1992 by the UN Conference on Environment and Development. Information, integration, and

participation were cited as essential building blocks to assist nations in developing in a way that respects these interconnected pillars in Agenda 21's action plan for sustainable development. Furthermore, Agenda 21 underscores that attaining sustainable development is fundamentally dependent upon extensive public engagement in decision-making.

With the Rio Protocol, the world came to an agreement on a sustainability agenda for the first time. In fact, ignoring specific objectives and practical details helped to achieve a global agreement. Contrary to the outcomes of the Rio Process, the Sustainable Development Goals (SDGs) now include concrete targets, but no mechanisms for sanctions.

### **Environmental Characteristics Of Sustainable Cities**

A sustainable city is one where urban management and planning are used to reduce the urban area's environmental impact. Imagine a city with parks and green areas, solar powered structures, rooftop gardens, and more people on foot and bicycles than in motor vehicles for the description of an eco-city. This is not a vision of the future. Better environmental management and greener urban ecosystems are active goals of smart cities.

Sustainability in the environment refers to the natural environment's ability to endure, remain diverse, and be productive. The condition of the air, water, and climate are of particular relevance because natural resources are drawn from the environment. In order to maintain environmental sustainability, civilization must develop activities that satisfy human needs while protecting the planet's life support systems. For instance, this calls for utilizing renewable energy, sustainable material resources, and wise water use (e.g. harvesting wood from forests at a rate that maintains biomass and biodiversity).

When natural capital, or all of the resources found in nature, are depleted more quickly than they can be restored, an unsustainable scenario results. Sustainable development calls for just using natural resources at a rate that allows for their natural replenishment. Carrying capacity and the idea of sustainable development are interwoven. The incapacity to support human existence is the long-term effect of environmental degradation, according to theory.

Herman Daly published key operational guidelines for sustainable development in 1990: renewable resources should provide a sustainable yield (rate of harvest should not exceed the rate of regeneration); for non-renewable resources, there should be equivalent development of renewable substitutes; waste generation should not exceed the environment's capacity for assimilation.

### **LAND USE CHANGES, AGRICULTURE, AND FOOD**

Sustainable agriculture, organic farming, and more environmentally friendly business methods are currently being used to alleviate environmental issues caused by industrial agriculture and agribusiness. Afforestation, sustainable forest management, and minimizing

deforestation are the most economical methods for addressing climate change. Diverse movements, such as those promoting less meat consumption, regional food production, slow food, sustainable gardening, and organic gardening, are active at the local level. The percentage of animal and plant foods consumed as well as the technique of food production all affect how varied dietary patterns affect the environment.

## **MATERIALS AND METHODS**

The volume, variety, and distance traveled by diverse materials have all expanded along with the growth in world population and wealth. Raw resources, minerals, synthetic chemicals (including dangerous compounds), manufactured goods, food, living things, and garbage are all included. Unless the rate of economic expansion is separated from the rate of natural resource consumption, by the year 2050, humanity may use an estimated 140 billion tonnes of minerals, ores, fossil fuels, and biomass annually (three times its present consumption). The annual per capita use of those four essential resources by inhabitants of developed countries is 16 tonnes, with some developed countries having per capita resource consumption levels of 40 tonnes or higher. By comparison, the average person in India today consumes four tons per year.

The concept of dematerialization has been the focus of sustainable material use, which has changed the linear flow of materials (extraction, use, and landfill disposal) to a circular material flow that reuses resources as much as possible, similar to how garbage is recycled and used in nature. The concepts of industrial ecology, eco-design, and ecolabelling promote dematerialization.

The circular economy is a concept that embodies this style of thinking. It uses reuse, sharing, repair, refurbishment, remanufacturing, and recycling to produce a closed-loop system that reduces resource input use, waste production, pollution, and carbon emissions. The possibility of using reusable energy and decreasing waste presented a perspective on sustainable development, and building electric vehicles has been one of the most popular techniques in the sector. A comprehensive Circular Economy Action has been adopted by the European Commission. ecosystem services and biological diversity.

The largest and most thorough assessment of biodiversity and ecosystem services to date was summarised for policymakers by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services in 2019. It suggested that a transformational change in human society would be necessary, including sustainable agriculture, decreases in waste and consumption, fishing quotas, and cooperative water management.

The IPCC report from 2022 highlights the numerous research that have been conducted on biodiversity loss and offers more suggestions for slowing down the rate of biodiversity loss. The paper makes recommendations for how to protect natural ecosystems, manage fire and soil, and lessen land competition in order to have a good influence on the environment and promote



sustainable development. 2020 plan aims to standardize sustainable products across the EU.

## **MANAGEMENT OF HUMAN CONSUMPTION AND IMPACTS**

A community's or humanity's overall environmental impact depends on both population and impact per person, which in turn depends on a number of complex factors, including the resources being used, whether or not they are renewable, and the scale of human activity in relation to the carrying capacity of the ecosystems in question.

Careful resource management can be used at many different scales, including work organizations, family and individual consumption patterns, and the resource requirements of specific commodities and services. Economic sectors including agriculture, manufacturing, and industry are just a few examples.

Human consumption is the fundamental force behind direct human effects on the environment. Consuming less is one way to lessen this impact, but another is to make the entire cycle of production, usage, and disposal more sustainable. At all scales along the consumption chain, from the effects of individual lifestyle decisions and spending habits to the resource demands of particular goods and services, the effects of economic sectors, through national economies to the global economy, consumption of goods and services can be analyzed and managed. Food, energy, raw materials, and water are important resource categories that relate to human requirements.

## **IMPROVING ECONOMIC AND SOCIAL ASPECTS**

It has been proposed that natural capital, or environmental resources, be treated as significant economic assets due to rural poverty and overexploitation. Growing GNP has always been a requirement for economic development. This paradigm of unrestricted GDP and personal growth might be outdated. While many people's lives may improve as a result of sustainable development, it may also be necessary to reduce resource usage. The direct impact that the environment may have on social welfare is typically disregarded by "growth," whereas it is considered in "development."

When ambitious climate change mitigation efforts are not in line with sustainable development objectives, they can have detrimental social and economic effects, as was noted in the IPCC's Sixth Assessment Report in 2022. The implementation of policies aimed at constructing a low-carbon future may be hindered by other limiting factors like poverty, food insecurity, and water scarcity, so the transition towards sustainable development mitigation policies has slowed down. As a result, the inclusivity and considerations of justice of these policies may weaken or support improvements in some regions.

## **GENDER AND LEADERSHIP IN SUSTAINABLE DEVELOPMENT**

Examining the relationship between gender and sustainable development has focused on the leadership potential and challenges faced by women. Patriarchal systems and views continue to prevent women from holding leadership positions in sustainable development, despite the fact that these roles have evolved to become more androgynous. Women's low self-esteem and barriers to leadership positions are some unspoken problems, but men may be able to support women in leadership posts.

## **BARRIERS TO SUSTAINABLE DEVELOPMENT**

Small and medium-sized businesses must overcome obstacles while implementing sustainable development, including a lack of resources, a lack of resources, and a high initial capital cost.

The political will to achieve sustainable development is lacking. Governments must come to a united consensus of social and political strength to overcome this obstacle. Progress toward the present and long-term environmental sustainability goals is made possible by initiatives to adopt reforms or create and implement programs to lessen the negative effects of human behavior. The Paris Pact, a multilateral agreement between 193 parties designed to enhance the international response to climate change by cutting emissions and cooperating to adapt to its effects, is an example of global political will at work. Experts are still adamant that nations should take more action outside of the Paris Agreement, but political will is still more important than ever.

Negative externalities that could possibly result from using sustainable development technology would be another obstacle to sustainable development. The creation of lithium-ion batteries is one instance; these batteries are essential for environmental sustainability and the decline in the use of fossil fuels. The extraction of lithium from the earth, which uses a technique very similar to fracking, and its processing to be used as a battery, which is a chemically intensive process, however, has a detrimental influence on the environment at the present time.

## **SUSTAINABLE DEVELOPMENT GOALS**

The Sustainable Development Goals (SDGs), also known as the Global Goals, are a set of 17 interrelated goals that are meant to act as a "common blueprint for peace and prosperity for people and the planet today and into the future." Inequality, Sustainable Cities and Communities, Responsible Consumption and Production, Climate Action, Life Below Water, Life On Land, Peace, Justice, and Strong Institutions and Partnerships for the Goals are some of our objectives. Other objectives include No Poverty, Zero Hunger, Good Health and Well-

Being, Quality Education, Gender Equality, Clean Water and Sanitation, Affordable and Clean Energy, Decent Work and Economic Growth, Industry, Innovation and Infrastructure, and Inequality. By placing sustainability at their core, the SDGs highlight how the environmental, social, and economic facets of sustainable development are interconnected.

The UNGA created the SDGs in 2015 as part of the Post-2015 Development Agenda, which aimed to design a new global development framework to replace the Millennium Development Goals, which were completed that year. Informally referred to as Agenda 2030, they were formally stated and adopted in a UNGA Resolution dubbed the 2030 Agenda. A UNGA decision that defines precise targets for each goal and offers indicators to gauge progress made the SDGs more "actionable" on July 6, 2017. Although some goals have no set deadline, the majority are to be accomplished by 2030. There are challenges that cut across all the goals and connections between them. For instance, SDG 13 on climate action has strong connections with SDGs 3 (health), 7 (clean energy), 11 (cities and communities), 12 (responsible consumption and production), and 14 according to the IPCC (oceans). On the other hand, detractors and observers have also noted compromises between the objectives, such as between eradicating hunger and advancing environmental sustainability. Other issues include having too many objectives (which exacerbates trade-offs), placing insufficient emphasis on environmental sustainability, and having trouble tracking qualitative indicators.

## **EDUCATION FOR SUSTAINABLE DEVELOPMENT**

The United Nations uses the phrase "education for sustainable development" (ESD), which is defined as education that promotes changes in knowledge, skills, values, and attitudes to make it possible for all people to live in a more sustainable and just society. ESD aspires to use a balanced and integrated approach to the economic, social, and environmental components of sustainable development to empower and equip present and future generations to satisfy their requirements.

Agenda 21 was the first international document that identified education as an essential tool for achieving sustainable development and highlighted areas of action for education. ESD is a component of measurement in an indicator for Sustainable Development Goal 12 (SDG) for "responsible consumption and production". SDG 12 has 11 targets and target 12.8 is "By 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature." 20 years after the Agenda 21 document was declared, the 'Future we want' document was declared in the Rio+20 UN Conference on Sustainable Development, stating that "We resolve to promote education for sustainable development and to integrate sustainable development more actively into education beyond the Decade of Education for Sustainable Development."

One approach to education for sustainable development acknowledges the current

environmental problems and aims to define new solutions to deal with a changing biosphere as well as involve people in addressing the societal problems that go along with it. This educational strategy is described as an effort to "shift consciousness toward an ethics of life-giving relationships that respect the interconnectedness of man to his natural world" in the International Encyclopedia of Education in order to give future members of society environmental awareness and a sense of responsibility to sustainability.

### **For UNESCO, education for sustainable development involves:**

Incorporating important sustainable development problems into classroom instruction. This can involve teaching students about topics like biodiversity, disaster risk reduction, climate change, eradicating poverty, and sustainable consumption.

Additionally, it calls for active learning and teaching strategies that inspire and equip students to alter their behaviour and take initiative for sustainable development. As a result, ESD encourages skills like critical thinking, creating scenarios for the future, and working together to make decisions.

The Thessaloniki Declaration, made by UNESCO and the Greek government in December 1997 at the "International Conference on Environment and Society: Education and Public Awareness for Sustainability," emphasizes the significance of sustainability not only in terms of the natural environment but also in terms of "poverty, health, food security, democracy, human rights, and peace."

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## Chapter 3

### CONSTITUTIONAL FRAMEWORK FOR PROTECTION OF ENVIRONMENT IN INDIA : AN OVERVIEW

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#### ABSTRACT

In India's constitutional framework as well as in its international commitments, the need for environmental protection, conservation, and sustainable resource use are expressed. The Stockholm Conference, rising environmental consciousness, and the international movement for environmental protection in the 1970s prompted the Indian government to enact the 42nd Amendment to the Constitution in 1976. India has ratified numerous international statutes, agreements, and treaties based on these clauses. Ramsar Convention on Wetlands, Kyoto Protocol, UNFCCC Climate Conventions, Montreal Protocol, Biological Diversity Convention and other agreements. Several Acts were passed under this provision to implement the Stockholm Conference, including the Environmental (Protection) Act of 1986 and the Air (Prevention and Control of Pollution) Act of 1981. The preamble of Indian constitution guarantees the socialist social structure and human dignity. This has a built-in decent level of living and a clean environment. The Indian Constitution includes environmental protection as one of its Fundamental Duties, Directive Principles of State Policy, and Fundamental Rights. The judiciary established the Right to a Clean Environment as one of the Implied Fundamental Rights under Fundamental Rights (Part-III) using Articles 14, 19, 21, and 32 as well as additional articles like 47, 48A, 51A(g), 226 and 253. To combat the danger of noise pollution, the Supreme Court. Using loudspeakers or sound amplifiers is not protected under Article 19 of the Constitution, the court ruled in the PA Jacob case. The Apex court ruled in *Subhash Kumar V. the State of Bihar* that Article 21's right to clean water and air, qualifies as a fundamental right. The court ruled in the Dehradun Quarrying Case that article 21 naturally leads to the right to a healthy environment. In this instance, the Environment Protection Act was invoked. The present paper is totally based on secondary source of data such as legal Journal, books, Magazines, Newspaper and web sources etc.

*Key Words: Enactments on Environment, Constitutional Provisions on Environment, International Conference on Environment etc.*

## **INTRODUCTION:**

The term environment has been derived from a French word “Environia” means to surround. It describes both the physical and biological (or alive) environments. Environment refers to the physical surrounds of an organism. An ecosystem, which affects the well being of the entire planet Earth, forms the foundation of a biosphere include both live and non-living elements of the environment. Humans have tried to alter the parameters of their physical environment through advancements in science and technology. These changes, which ultimately aim to bring about civilization and urbanisation, include modern infrastructure in cities, our homes and associated amenities, our modes of communication and transportation, our reliance on conveniences and luxury, various types of electrical appliances, industry producing luxurious goods, and so on. Every person who lives in an environment has an impact on it because the environment affects how people behave.

## **Judicial Interpretation of Constitutional provisions on Environment Issues:**

As a result, there is a connection between and benefit to both individuals and the environment. Without the environment, not only would human life end, but that of all other living creatures, according to Article 246 of the Constitution. The Union List (List I) contains interstate transportation, atomic energy, air trafficking, oilfields, mining, and interstate rivers. It also includes international affairs, nuclear energy, and interstate transportation. Agriculture, water resources, irrigation and drainage, fisheries, and public health and sanitation are all included in the State List (List II). Forests, the preservation of animals, the mining of minerals, unlisted development, population management, and manufacturing are all included in the Concurrent List (List III), under which both the State and the Union may pass laws. The distribution of legislative power is significant from an environmental point of view because some environmental issues, like waste management and sanitation, are best handled locally, while others, like water pollution and wildlife preservation, require a more national level of attention. The Constitution's part XI specifically addresses the legislative and administrative relationships between the federal government and the state governments. The state government of each state, as opposed to the national parliament, has the authority to enact laws for the entire nation. The Hon'ble court further held that the open spaces, recreation, playing fields, and protection of environment are the concerns of fundamental importance in the interest of the general public and essential for the development in *Bangalore Medical Trust V. B.S. Mudappa*. The preservation of public open spaces is justified, and they cannot be sold or leased to a private party only to make money. the *Narmada Bachao Andolan V. Union of India* case before the Indian Supreme Court. The construction of the Sardar Sarovar Dam on the Narmada River was the problem in this instance. In this case SC laid down some important guidelines which are: .

- The tribunal's instructions on the construction of the dam must be followed;

- The Environment Sub-group, which reports to the Secretary of the Ministry of Environment & Forests in India, must provide its environmental approval.
- The Relief and Rehabilitation Sub-group was to provide its approval before the dam's construction could begin.
- Periodically, the Narmada Control Authority was required to grant permission for the dam's height to be increased over 90 metres.
- The reports of the Grievances Redressal Authorities were to be followed by Gujarat, Maharashtra, and Madhya Pradesh.
- The Environment Sub-group was to keep track of everything and make sure that all measures were made to not only protect but also to improve and restore the environment.
- The Review Committee was obligated to convene on a regular basis to settle outstanding issues.
- In order to provide relief and rehabilitation of pari passu with the rise in the height of the dam, an action plan was to be put into place.

In *Virender Gaur V. State of Haryana*, it was decided that protecting and preserving the environment is a necessary part of enjoying life and the right to live in dignity. Without the environment, enjoyment of life is impossible. The Swaran Singh Committee advocated adding Articles 48A and 51A to the Indian Constitution's separate Fundamental Duties under chapter 4 A, which was influenced by the Stockholm Convention, which the Indian Prime Minister attended at the time.

The State is required by Article 48A to safeguard the woods and wildlife as well as to maintain and develop the environment. Wildlife and forests have been added to the concurrent list to enable this responsibility, allowing both the Central Government and State Government to fulfil their responsibilities for wildlife protection. The National Green Tribunal ruled in *Sher Singh v. State of HP* 2014 that the State has a fundamental duty to safeguard and improve the environment. The court determined that Articles 39(e), 47, and 48A combined imposed an obligation on the State to ensure public health and environmental preservation in *M.C. Mehta V. Union of India*.

Article 51A(g)

Citizens have a fundamental obligation to conserve and maintain the environment, according to article 51A(g).

In *A.I.I.M.S students union V.A.I.I.M.S*, the SC ruled that the obligation of citizens under Article 51-A does not preclude the obligation of the states.

In *Sachidananda Pandey V. State of West Bengal & Ors*, it was further decided that anytime a court is presented with an ecological issues, Article 48 A and 51A (g) must be taken into account. It was also considered what the judiciary should do. The supreme Court made it clear that even though they are a guiding concept, the court must uphold the obligations under

Article 51A. The *Vellore Citizens Welfare Forum V. Union of India*, 1996 case is considered to be the primary legal authority in India for the concept of sustainable development, the precautionary principle, and polluter pays. The court may examine whether appropriate considerations are taken while developing a policy under Article 51A. The applicability of these ideas in India was formalised by this case. In *Charan Lal Shahu V. Union of India*, it was determined that the state's responsibility is to take reasonable and decisive action to uphold and preserve constitutional rights protected by Article 21, 48A and 51A(g).

## **CONCLUSION:**

From the study of aforesaid matter we can draw a conclusion that the Supreme Court has gone so far as to create "green benches" in both the Supreme Court and the country's various High Courts to handle only environmental cases. Two public interest writ petitions pertaining to India's forests and Delhi's massive car emissions are currently being heard by the Supreme Court. As a result, the law in India has developed in a way that seeks to improve the quality of the individual's life. It is indeed a novel strategy to interpret and apply the fundamental rights provisions in conjunction with directive principles of state policy and fundamental duties in order to provide substantive remedy. In *Union of India V. M.C. Mehta* (Vehicular Pollution Case). It was decided that it was the responsibility of the government to prevent vehicle pollution from contaminating the air. The Supreme Court reiterated that the right to a healthy environment is a fundamental human right and that the right to clean air also derives from Article 21 of the Constitution, which deals with the right to life. Due to this case, lead-free gasoline was made available in Delhi, marking a significant historical milestone. Old commercial cars older than five years were completely phased out, as instructed by the courts. The efforts made to maintain clean air are to thank for Delhi's current climatic conditions. It is undoubtedly an innovative approach to interpret and implement the provisions of the basic rights law in conjunction with the overarching tenets of public policy and the fundamental obligations of citizens in order to offer effective relief. The only means to ensure the environment for future generations has been through judicial interpretation of several current constitutional clauses and environmental legislation. One cannot disregard the importance of the environment in influencing the development process at a time when the nation's development is at its height. Nevertheless, it is the judiciary that has made bold and creative decisions to interpret the constitutional provisions for environmental preservation. Currently, we all require Having a healthy environment is crucial because it encourages the health of a larger population. India is the second largest country in the world after China.

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## Chapter 4

# SUSTAINABLE DEVELOPMENT

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### ABSTRACT

Development which meets the present essential needs without compromising future of coming generations to meet their own needs. (World Commission on environment and development, Our Common Future-1987) [1].

In 1992, Earth summit in Rio de Janeiro first institutionalized the term Sustainable development. United Nations General assembly (In 2015, UNGA) first adopted the goal of sustainable development for the period 2015 to 2030 [2]. 17 goals of UNGA focus on global challenges such as Poverty, climate change, inequality, peace, justice and environmental degradation [1].

UNESCO presented a distinction between concept of sustainability and sustainable development, in it “Sustainability is often thought of as a long term goal ( a more sustainable world), while sustainable development refers to the many processes and pathways to achieve it” [3]. Some people see sustainable development as paradoxical ( or as an oxymoron) and termed development as inherently unsustainable [4,5]. Big problem is that term development itself is not defined clearly and consistently [6,7].

It is to develop a society where resources and living conditions fulfil human needs without compromising the planetary integrity and purity of natural system [8,9].

*Key Words: sustainable development, sustainability, environmental degradation, growth and natural resources.*

### INTRODUCTION:

#### Development of the concept:

The idea sustainable development sprouted from an idea of sustainable forest management which was developed in Europe during 17<sup>th</sup> and 18<sup>th</sup> centuries [10,11]. A awareness



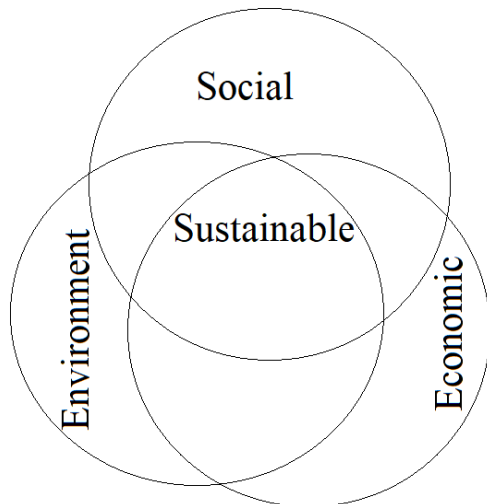
grown due to depletion of timber resources in England. A essay *Sylva* was written in 1662 by John Evelyn state that it was national duty of every landowner to sow and plant trees in their field, so that damaging over exploitation of natural resources could be stopped. Hans Carl von Carlowitz ( in 1713), a senior mining administrator worked for Elector Frederick Augustus I of Saxony wrote *Sylvicultura economica* on forestry and gave the concept of Sustained Yield to manage forests [10]. His work influenced other scholars like-Alexander von Humboldt and Georg Ludwig Hartig and eventually contributed in the development of science of forestry. Land Ethic report of Aldo Leopold was very important to lead Environmental movement in 1960 [10,11].

A book, *Silent Spring* of Rachel Carson was published in 1962 and it influenced environmental movement which drew attention about the connection between environmental degradation and economic growth. In 1966, a essay *The Economics of the Coming Spaceship Earth* of Kenneth E. Boulding pointed out the requirement for the economic system to fit with ecological system and resources [11]. A article by Garrett Hardin (in 1968) popularized the term *Tragedy of the Commons* was another milestone [7]. A classic report on the *Limits to Growth* by the Club of Rome in 1972 reported one of the first use of term sustainable in contemporary sense, this report was written by Dennis and Donella Meadows scientists of the Massachusetts institute of technology. To explain the State of Global Equilibrium, the authors pointed out “We are searching for a model output that represents a world system that is sustainable without sudden and uncontrolled collapse and capable of satisfying the basic material requirements of all of its people” [12]. MIT research group prepared a ten days hearing report on “Growth and its Implication for the Future” for the US Congress, it was first hearing ever held on Sustainable Development [13].

International Union for Conservation of Nature published (in 1980) a strategy to conserve the world, it included one of the first references for sustainable development and termed it as a global priority [14] and it introduced the term “Sustainable development” [15]. After two year, *World Charter for Nature* developed by United Nations report five principles of conservation which emphasized that human conduct affect nature should be guided and judged [16].

The UN Conference on Environment and Development (in 1992) gave a report on *Earth Charter*, which emphasized the building of sustainable and peaceful global society in 21th century. *Agenda 21* was the action plan for sustainable development recognized information, integration and participation as main features to help countries, so that they can achieve development with these interdependent pillars, it also emphasized that broad public participation should be employed in decision making to achieve this goal [17].

A huge leap was The Rio Protocol, the world agreed first time on sustainable agenda. The Sustainable Development Goals (SDG) have essential targets but no methods were adopted for sanctions [18,6].



### Factors Include Sustainable development

Sustainability is essential goal of a educated society which depend on the ability of the people how safely they co-exist on Earth for long time. Specific definition of sustainability is very difficult to form and get consensus [19,20]. The sustainability has three dimensions or pillars such as economic, environment social pillars [19]. Several publications report that environmental pillar is most important [21,22]. This is the reason , sustainability mainly focus on environmental problems, like-loss of biodiversity, climate change, loss of ecosystem services, air pollution, water pollution and land pollution. The sustainability concept may be used to observe decisions validity at global, national and individual levels (sustainable living) [23].

#### **CRITIQUE:**

Some scholars criticize the concept of sustainable development. One argument given to counter sustainable development is that there is nothing like sustainable when we use non-renewable resources. Any type of exploitation of resources will eventually lead to the exhaustion of finite resources of Earth [24]. This perspective put whole industrial revolution as unsustainable [25,26,27]. Assumption of the debate is that societies are need to control three types of Capital (social, economic and natural) , whose consumption may be irreversible [28]. Natural capital is very difficult to be substituted by economical capital [27]. There are several angles against the sustainable development, many see it as paradoxical ( or an oxymoron) and termed it as inherently unsustainable. Many are disappointed to observe the progress so far

achieved [4,5]. The definition of sustainable development of Brundtland has been criticized as, this definition “opened up the possibility of downplaying sustainability. Hence, governments spread the message that we can have it all at the same time, i.e. economic growth, prospering societies and a healthy environment. No new ethic is required. This so-called weak version of sustainability is popular among governments and businesses, but profoundly wrong and not even weak, as there is no alternative to preserving the earth’s ecological integrity” [29]. It is observed that six interdependent capacities are necessary to pursuit the goal of sustainable development (SD) [1]. 1-capacity to measure progress toward SD, 2-promote equity between generations, 3-adapt to shocks and surprises, 4-transform the system to more SD pathways, 5-link knowledge with action and 6-devise governance arrangements which encourage the people to work together.

### **SUSTAINABLE CITIES:**

It may be termed as eco-city. A city which has parks and green spaces, rooftop gardens, solar powered building and more pedestrians and bicycles than cars. Smart cities are converting towards greener urban ecosystems and better management of environment [30].

Environmental sustainability demand a society which design its activities to fulfil human needs at the same time preserving the ecosystem of the planet [31]. Unsustainable situation comes when natural resources consume faster than it is replenished [32].

### **SUSTAINABILITY AND AGRICULTURE:**

Industrial and agricultural activities lead pollutions, this problems may be addressed by using the concepts of sustainable agriculture, organic farming and sustainable business practices [33]. The cost effective climate change mitigation can be obtained through afforestation, sustainable forest management and decreased deforestation [34].

### **MATERIALS AND WASTE:**

Since global population and industrial units increasing day by day, thus thousands type of materials use increase in volume and increase in transportation. Materials include raw materials, minerals, synthetic chemicals, hazardous substances, manufactured products, food and waste [35]. Humans can consume about 140 billion tons of ores, minerals, fossil fuels, raw materials and biomass per year by 2050, which is three times of present data. In developed countries, citizens consume on an average 16 tons resources per capita per year, while in India, a person consumes about 4 tons per capita per year [36].

## **ECONOMIC AND SOCIAL ASPECTS:**

Environmental resources should be treated as valuable economic assets which is now known as natural capital [37]. Sustainable development may improve the quality of life for many but it should be with decrease in natural resource consumption [38]. Growth is considered to ignore direct effect on environment and then on society, whereas development include environmental aspect into its action plan [39].

World Bank study (in 1999) gave its report based on the theory of genuine savings as “traditional net saving less the value of resource depletion and environmental degradation plus the value of investment in human capital”. Policymakers face many interventions to increase sustainability [40].

In 2021, The World Business Council for Sustainable Development gave a report on Vision 2050 document, its state “How business can lead the transformations the world needs” and “we envision a world in which 9+ billion people can live well, within planetary boundaries, by 2050” [41]. It was reported by The Guardian as “the largest concerted corporate sustainability action plan to date-include reversing the damage done to ecosystems, addressing rising greenhouse gas emissions and ensuring societies move to sustainable agriculture” [42].

## **Renewable Energy is most important for sustainability:**

Renewable energy is obtained from those natural resources which replenishes very fast when they are consumed. Solar energy, hydroelectricity and wind energy are some examples of this energy. Renewable energy resources are available everywhere in very vast quantity.

## **TYPES OF RENEWABLE ENERGY:**

Renewable energy resources are mainly of six types and these are available everywhere around the world. Biomass energy is not clean and produce large amount of greenhouse gases, while all other renewable energies are very clean and produce not any specific pollutions and they do not release any harmful gases or pollutants in environment. These are also known as green energy. These energy sources can provide sustainable developments. The renewable energy sources are wind energy, solar energy, hydroelectricity, ocean energy, geothermal energy and bioenergy [34,44,45].

## **Adverse effects of conventional energy techniques on the environment:**

Some non-renewable energy resources are found in nature in the form of fossil fuels (petroleum, oil, coal and gas), woods, biogas, electrochemical energy and combustible gases (H<sub>2</sub>, Hydrocarbon). We know that fossil fuels take millions of years in their formation while they consume very fast. Fossil fuels when burnt produce large amount of greenhouse gases (CO<sub>2</sub>, CH<sub>4</sub>, SO<sub>2</sub>, SO<sub>3</sub>, N<sub>2</sub>O) with high number of oxides of nitrogen, phosphorous and sulphur

with huge amount of fly ash and solid wastes [43,44,45].

## CONCLUSION:

In spite of the several criticisms comes from different scholars for the concept of sustainable development and sustainability, it very clear that we have no option except sustainable development because current air, water and soil pollutions reversing all benefits of development and scientific advances. Natural resources are being depleted with time, we have no option except to conserve them and use them optimally. We cannot keep continue to contaminate our natural resources as we are doing nowadays, otherwise they will produce fatal health problems. These contaminations of natural resources and food items will lead serious survival issues, on the other hand, depletion of some natural resources force us to think about renewable resources and sustainable development.

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## *Chapter 5*

### **ENVIRONMENTAL LEGISLATION IN INDIA**

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#### **ABSTRACT**

India had an ancient tradition of paying constant attention to protection of the environment. There are writings galore, to show that in ancient India every individual had to practice the dharmato protect and worship nature. In India the devices and rules for protecting the environment are discernible from ancient times.

Environmentalism is not a fixed concept, but is always evolving influenced by its context. This also applies to Indian environmentalism, which has developed and changed throughout the years. There is a rapid evolution in the Indian legislations after independence as the need and concern regarding environment arose. From ancient environmental rules including Buddhism and Jainism to medieval and then from British era to afterwards and the coming of modern legislations on environmental laws in India, a great sense of concern has been shown by the legislature and even the Indian judiciary showed a great concern regarding the environment with its landmark judgments.

In India, the concern for environmental protection has not only been raised to the status of fundamental law of the land, but it is also wedded with human rights approach and it is now well established that, it is the basic human right of every individual to live in pollution free environment with full human dignity.

It is high time that the general public, public entities, state and central government realize the damage, which our developmental process has made to the living environment. For the success of the local government laws relating to the environment it is essential to create a sense of civic consciousness and public hygiene in the use of municipal services like roads, public places, drainage etc. Strict enforcement of the provisions of law also is needed. Law is a strong medium to compel the citizens to observe cleanliness and thereby to combat pollution. Environmental protection laws in India need a new orientation in the modern context.

Environment The outer physical and biological system in which man and other organisms live has been defined as the environment. The physical and biological environments of humans make up the human environment. Land, water, and air make up the physical environment. Plants,

animals, and other organisms are all included in the biological environment.

The Environmental Protection Act of 1986 defines the term "environment" as "water, air, and land" as well as the complex physical, chemical, and biological factors surrounding an organism or ecological community. The term "environment" derives from the verb "environ," which means "to surround." The term "environment" means "surrounding conditions, circumstances affecting people's life." These factors affect the form, growth, and survival of various species and organisms by acting and interacting with them. Environmental pollution is any negative change to this environment. The most prevalent forms of pollution are thermal, radiation, air, water, and land.

Clearly, the "Environment" includes all external entities—living and non-living, natural or man-made—that provide value to humanity now or in the future and their interrelationships. Concerns about the environment stem from the deterioration caused by human activity.

The objectives of environmental policy can be formulated in a number of ways, including safeguarding human health, guaranteeing the viability of wild life, preserving historic landmarks, preventing further environmental degradation, and other objectives.

**Environmental Law in India** In addition to international laws, every nation has environmental protection, pollution control, and other laws. A number of environmental protection acts in India mandate that the government take care of the environment.

**Policy and Law in Medieval India (1638–1800 AD)** For Mughal rulers, forests were merely hunting grounds. Medieval India's history is dominated by Muslim rulers, and environmental law did not develop significantly until Akbar, the Mughal emperor, took power. Hunting and shikar were outlawed during Akbar's reign, with the exception of rulers. However, because the rulers were only concerned with war, the propagation of religion, and the construction of empires, no significant efforts were made during the medieval period to prevent environmental protection and the preservation of natural resources. There was no restriction on cutting other trees, hunting animals, or anything else, with the exception of "royal trees" that were cut for a fee. During this time, the size of forests decreased steadily.

The Shore Nuisance (Bombay and Kolaba) Act of 1853 restricted the fouling of seawater in British India from 1800 to 1947.

- The Merchant Shipping Act of 1858 dealt with oil pollution of the sea.
- The Fisheries Act of 1897; • The Bengal Smoke Nuisance Act of 1905; • The Bombay Smoke Nuisance Act of 1912; • The Wild Birds and Animals Protection Act of 1912; • Laws after Independence (1947) The Indian Constitution, which was adopted in 1950, did not address the issue of pollution prevention and control as such. Indian post-independence policy prioritized economic growth and poverty alleviation over resource conservation.

The adoption of the "Declaration on the Human Environment" at the United Nations Conference on the Human Environment in Stockholm (Sweden) in June 1972 marked a turning

point in environmental policy. This could be regarded as the beginning of the global environmental movement.

Perhaps the first significant international effort to preserve and protect the human environment was the 1972 Stockholm Declaration. "the need for a common outlook and for common principles to inspire and guide the peoples of the world in the preservation and enhancement of the human environment," it states in its preamble. As a result of this Declaration, the States were required to adopt environmental protection and enhancement legislation. As a result, in 1976, the Indian Parliament added two articles to the Indian Constitution, 48A and 51A. In order to guarantee a healthy environment for the nation, the Department of Environment was established in India in 1980.

**The main acts for environment protection in India are as follows:-**

1. The Forest Conservation Act, 1980
2. The Prevention of Air and Water Pollution, 1974, 1981 (The Central Pollution Control Board) (CPCB) was constituted under this act.
3. The Air Prevention and Control of Pollution, 1981.
4. The Atomic Energy Act. 1982.
5. The Environmental Protection Act, 1986. (It came into force soon after the Bhopal Gas Tragedy)
6. The Environmental Conservation Act. 1989.
7. The National Environmental Tribunal, 1995.
8. National Environmental Appellate Authority Act, 1997.
9. National Environment Management Act (NEMA), 1998
10. Handling and Management of Hazardous Waste Rule in 1989.
11. The Public Liability Insurance Act (Rules and Amendment), 1992.
12. The Biomedical Waste Management and Handling Rules, 1998.
13. The Environment (Siting for Industrial Projects) Rules, 1999.
14. The Municipal Solid Waste (Management and Handling) Rules, 2000.
15. The Ozone Depleting Substance (Regulation and Control) Rules, 2000.
16. The Biological Diversity Act 2002.

The Indian Constitution and the Environment The Indian Constitution is one of the few in the world that specifically addresses environmental protection.

The rights and responsibilities that are outlined in the constitution and the common law are supplemented by laws enacted by the federal, provincial, and local governments. These laws, which are also known as laws, must adhere to the constitution, but they can be changed by popular vote.

Article 21 is the foundation for both the protection of life and personal liberty. "No person shall be deprived of his life or personal liberty except in accordance with procedure established by law," it states.

The "right to equality" of all individuals is guaranteed by the Indian Constitution. This indicates that the "State" must not violate the equality right outlined in Article 14 of the Constitution by taking environmental actions. This principle of equality in environmental management was also acknowledged in the 1972 Stockholm Declaration, which urged all nations to adhere to it.

The state has a responsibility to "protect and improve the environment and to safeguard the forests and wildlife of the country," according to the Indian Constitution. Every citizen is obligated to "protect and improve the natural environment including forests, lakes, rivers, and wildlife." Let us investigate the Indian Constitution's environmental protection provisions in greater detail. In 1974, the 42nd Amendment to the Constitution made it the state government's responsibility to protect and improve the environment as well as the country's forests and wildlife. Under the latter's fundamental duties, it is the fundamental duty of every citizen to have compassion for living things and to preserve the natural environment, including forests, lakes, rivers, and wildlife.

According to Article 47, "It is the duty of the state, to raise the level of nutrition, the standard of living, and to improve public health, the state shall endeavor to bring about prohibition of the consumption of intoxicating drinks and drugs which are harmful to health except for medicinal purposes." Art. According to 48A, the state must make an effort to preserve the country's forests and wildlife as well as to improve the environment. "

Art. "It shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers, and wild life, and to have compassion for living creatures, as well as to develop the scientific temper, humanism, and the other spirit of inquiry and reform, as well as to safeguard public property and to abjure violence," reads Section 51A, which was added to the Constitution by the 42nd Amendment Act of 1976. " The Writ Jurisdiction granted to the Supreme Court by Article 32 and to all of the High Courts by Article 226 is one of the most novel provisions of the Constitution. These provisions grant the courts the authority to issue any appropriate writs, such as habeas corpus, mandamus, prohibition, quo warranto, and certiorari, as well as any other direction, order, or writ. Public Interest Litigations, one of the most dynamic and effective mechanisms for environmental protection, have emerged as a result of this.

The Constitution (Seventy-third Amendment) Act of 1992 and the Constitution (Seventy-fourth Amendment) Act of 1992 gave the panchayats and municipalities, respectively, constitutional status. The establishment of intermediate and district levels is provided by Article 243-B. Article 243-G gives the state legislature the authority to give the Panchayats the powers and authority they need to be an institution of self-government.

Agriculture, soil conservation, water management, and watershed development are among the topics in the Eleventh Schedule that are either directly or indirectly related to the environment: fisheries; farm forestry and social forestry; little from the forest; consuming water; sanitation and health care; and upkeep of community resources.

The following are some of the environmental-related topics covered in the twelfth Schedule:

Planning for cities, such as town planning, the regulation of land use and water supply; conservation and solid waste management, public health, sanitation, urban forestry, environmental protection, and ecological aspects; the provision of urban amenities like parks; grounds for cremation and electric crematoriums; regulation of tanneries and slaughterhouses to prevent animal cruelty.

**Judicial Contribution** The fundamental jurisprudence of the nation includes the individual's right to a pollution-free environment. The fundamental right to life and individual liberty is protected by Article 21 of the Indian Constitution. The right to life and personal liberty have been interpreted by the Supreme Court to include the right to a healthy environment. In a number of its decisions, the Court has said that the right to a clean environment, clean drinking water, and a clean atmosphere are all part of the right to life.

Through PIL, Mr. M.C. Mehta brought the concept of environmental jurisprudence back to life in India. Other people also played important but insignificant roles. The following are a few examples of significant decisions that contributed to the development of Indian environmental law:

**Narmada Bachao v. Union of India** In 1946, the government of Bombay and the government of the Central Provinces and Berar asked the Central Waterways, Irrigation, and Navigation Commission to investigate the Narmada river system for basin-wise development with flood control, irrigation, power, and navigational expansion as the goals. In 1968, the issue was referred to a tribunal established by the Inter-State Water Disputes Act of 1956. On August 16, 1978, the tribunal announced its award on the basis of an agreement between the chief ministers of four states—Maharashtra, Rajasthan, Gujarat, and Maharashtra. Consultations with the World Bank for a loan began in 1978 in order to meet the financial obligation. The loan was approved in May 1985, and the Ministry of Environment and Forest granted Environmental Clearance in 1987 with some restrictions.

The Supreme Court noted that the Sardar Sarovar Project would contribute to environmental preservation in a positive way. The people of Gujarat have been waiting for this project for a long time. The drought-prone and arid parts of the state will now have access to water. This will effectively stop the ecological degradation that was making these areas inhabitable due to salinity intrusion, desertification, depletion of ground water, fluoride and nitrite-contaminated water, and disappearing green cover. The ecology of water-scarce regions is in trouble, and bringing Narmada water to these regions will enable sustainable agriculture and the spread of green cover.

The availability of fodder will also improve, easing the strain on vegetation and biodiversity. The SSP will reduce air pollution caused by thermal general power of comparable capacity by producing clean, eco-friendly hydropower. The Court decided not to interfere with the dam's construction based on the above analysis because the advantages outweighed the disadvantages. The dam's construction was permitted with some restrictions. These Supreme Court interpretations of Article 21 have, over time, become the foundation of environmental law and assisted in the cause of protecting India's environment. Additionally, over the course of the past few decades, a number of environmental laws have been enacted.

The Taj Mahal Case saw the Supreme Court instruct coal and coke-based industries in the Taj Trapezium (TTZ) that were causing harm to Taj to either switch to natural gas or relocate outside of TTZ. The court was aware that industrial development in our country has unavoidable effects on the environment. However, the quality of the environment cannot be compromised by polluting the land, water, and air to such an extent that it poses a health risk to the area's residents. The Court stated, "Every citizen has a right to fresh air and to live in an environment free of pollution," demonstrating its deep concern for the environment.

The Supreme Court ordered the Forest Department to protect the following plants planted around the Taj Mahal:

“The Union Government is directed to release the funds immediately without waiting for receipt of the proposal from the U.P. Government on the basis of the copy of the report. The Divisional Forest Officer, Agra is directed to take immediate steps to ensure that water is supplied to the plants.” Funding may be settled with the U.P. Government later, but the officer is tasked with ensuring that plants do not wither in the event of a lack of funds.

The supreme court issued a number of orders, including a prohibition on the use of coal and coke and a mandate for businesses to switch to compressed natural gas (CNG).

### **Case of Ganges Pollution:**

In response to public interest litigations, the Supreme Court of India issued a number of judgments and orders against over 50,000 polluting industries in the Ganga basin. These instructions have saved millions of people from the effects of air and water pollution in eight Indian states' Ganga basin.

The irony of Kamal Nath's case is that the family of Kamal Nath, the government's Minister of Environment and Forests, was the subject of a Public Interest Litigation. from India The Span hotel in the Himachal Pradesh state is owned by the Minister's family. In order to beautify the motel, they diverted the Course of River Beas. The Motel's owners were ordered by the Indian Supreme Court to give the government the forest land. In *M.C. Mehta vs. Union of India*, AIR 1987 SC 1086 (commonly referred to as the "Oleum Gas Leak Case"), the Supreme Court considered the right to live in a pollution-free environment to be a fundamental right to life under Article 21 of the Constitution. of Himachal Pradesh and further order the removal of all kinds of encroachments using money from their own pockets.[18] The Supreme Court ruled that an organization is strictly and unconditionally liable to compensate all parties affected by an accident involving the escape of toxic gas when it is engaged in a hazardous or inherently dangerous activity and harm occurs as a result of an accident in the operation of such hazardous or inherently dangerous activity. It should not be acceptable for the business to claim that it exercised all reasonable care and that the damage did not result from its own negligence; rather, the company must bear all responsibility for compensating for such harm. One tort in which fault need not be established is absolute liability. In addition, the A.P. High Court ruled in the case of *T. Damodar Rao vs. S.O., Municipal Corporation, Hyderabad* (AIR 1987 A.P. 171) that the right to live in a healthy environment is specifically incorporated into Article 21 of the Constitution.

## CONCLUSION

In India, environmental protection has not only been elevated to the status of fundamental law, but it is also entwined with a human rights approach. It is now well established that every person has the fundamental human right to live in an environment free of pollution in full human dignity. It is past due for the general public, public organizations, and state and federal governments to acknowledge the harm that our development has done to the living environment.

It is essential to cultivate a sense of civic consciousness and public hygiene in the use of municipal services like roads, public places, drainage, etc. for the success of environmental laws enacted by local governments. The provisions of the law must also be strictly enforced. Law is a powerful tool for enforcing cleanliness and combating pollution among citizens. India's environmental protection laws require a fresh perspective in light of today's circumstances.

“How far must suffering and misery go before we see that the good earth is our mother and that if we destroy her, we destroy ourselves,” was a quote by Paul Bigelow Sears.

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## Chapter-6

### HEALTH IMPLICATIONS DUE TO CLIMATE CHANGE IN INDIA

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#### ABSTRACT

Climate changes include a raise in the temperature, changes in the drizzle, and increases in the frequency or intensity of some extreme weather events, and rising sea levels. These impacts admonish our health by affecting the food we eat, the water we drink, the air we breathe, and the weather we experience. It affects directly, by the increased intensity and frequency of extreme weather events (such as heat waves, floods and bushfires); and indirectly, through worsening air quality, changes in the spread of infectious diseases, threats to food and water, and effects on mental health. Children are at risk for several reasons. For example, children are more prone to heat stress and dehydration and are more sensitive to exposure to air pollution and smoke from bushfires. Their immune systems are not perfectly developed, putting them at increased risk of infections. They often need to confide in adults to keep them safe during emergencies and help them to recover afterward. Pregnant women are at increased risk of heat stress in the course of heat waves due to the physiological demands of pregnancy. They and their unborn babies are particularly delicate to exposure to air pollution and smoke from bushfires. Older people and people with pre-existing medical conditions are more vulnerable to dehydration, heat stress, infections, and exacerbation of heart and lung disease. People living in rural and remote areas i.e., people on low incomes and other vulnerable populations are also at increased risk, in part due to disproportion in underlying health outcomes and limited attainability of healthcare and other services. People living in rural or remote communes or along the coast are also at risk from utmost events such as bushfires, droughts, storms, and sea level rises.

*Keyword- Environment, Health, vulnerable, climate change*

#### INTRODUCTION-

A clean environment is important for human health and well-being. At the same time, the local environment can also be a source of stressors, for example, air pollution, noise, and hazardous chemicals that are very harmful to health. Climate change affects social and

environmental determinants of health; Clean air, safe drinking water, adequate food and safe shelter, for example changing the severity and frequency of health problems already present in that area for the betterment of the world.

Between 2030 and 2050 climate change is expected to cause approximately 250 000 additional deaths per year, from malnutrition, malaria, diarrhoea, and heat stress. Water problems and waterborne diseases are sensitive to climate and also show seasonal variation. Diarrheal diseases are more common during the rainy season. Increasingly variable rainfall patterns due to climate change are likely to affect the supply of fresh water. Globally, water scarcity already affects 4 out of 10 people. A lack of safe water can compromise hygiene and increases the risk of diarrhoeal diseases (which kill approximately 2.2 million people every year), trachoma (an eye infection that can lead to blindness), and other illnesses. When floodwaters become contaminated with animal waste, outbreaks of leptospirosis (bacterial disease) may occur. Outbreaks of rotavirus and cholera are also reported in past after floods. Lack of basic sanitation is also a contributory factor to the increase in waterborne diseases. Effects of extreme temperatures, climate change including heat waves, cold spells, and other extreme events will bring new and emerging health issues. Heat stress can make working conditions critical and increase the risk of cardiovascular, respiratory, and renal diseases. Air pollution and increasing aeroallergen levels are also high in extreme heat which can trigger asthma and other respiratory diseases. Climate change may affect human health by increasing ground-level ozone and or particulate matter air pollution.

## **METHODOLOGY-**

The data has been collected through the secondary data from technical and traditional government publications. Here we used limited publications on climate change and health.

## **DISCUSSION-**

One of the most hazardous/ prevalent environmental issues in India is air pollution. According to the 2021 World Air Quality Report, India is home to 63 of the 100 most polluted cities, with New Delhi named the capital with the worst air quality in the world. Vehicular emissions, industrial waste, smoke from cooking, the construction sector, crop burning, and power generation are among the biggest sources of air pollution in India. Our country totally depended on coal, oil, and gas due to rampant electrification which makes it the world's third-largest polluter, contributing over 2.65 billion metric tonnes of carbon to the atmosphere every year. In addition to air pollution, public of the nation also suffers from waterborne diseases like typhoid, cholera, and hepatitis, and nearly 400,000 deaths each year. Water pollution also damages crops, as infectious bacteria and diseases in the water used for irrigation prevent them from growing. Inevitably, freshwater biodiversity is also severely damaged.

In an interview with the Times of India, lead researcher at Pune-based Watershed Organisation Trust Eshwer Kale described the national water policy as very 'irrigation-centric'. Indeed, over 85% of India's freshwater is used in agriculture. This has led to a crisis in several states, including Punjab, Haryana, and western Uttar Pradesh. Climate change is a major public health threat. Climate change is leading to more frequent and acute weather events such as floods and storms. Extreme weather events can also have jolt on some of the social and economic factors of mental health by leading to unemployment, homelessness, or food and water insecurity. The effects of climate change are already threatening to human health; however, pregnant women and new-born baby are especially at high risk of related harm. National and global leaders need to urgently work together. Building on experience in preparing for and responding to emerging infectious diseases will be important to help minimize adverse effects in these and other vulnerable populations. More recently, a study conducted by the lancet commission on climate change and health 2019 revealed that the suitability of disease transmission (malaria and dengue) by mosquito vectors has increased over the past few years (Watts et al., 2019).

Other Studies suggest that the increasing temperature and frequency of extreme rainfall events in high mountains of South Asia are now more conducive to the survival and reproduction of disease-carrying vectors (Dhiman et al., 2011; Dhimal et al., 2015, 2021; Sarkar et al., 2019).

Increased cases of malaria with the rise in temperature and increased rainfall have also been reported from highland regions of Bangladesh, Pakistan, Bhutan, Nepal, and India (Bouma et al., 1996; Haque et al., 2010; Dhiman et al., 2011, 2019; Dhimal et al., 2014b; Wangdi et al., 2020), Sarkar et al. (2019)

## **CONCLUSION-**

Physiological impacts such as rise in climate-sensitive infectious diseases, morbidity and mortality due to heat waves, increase in non-communicable diseases (NCDs), injury, and illness related to extreme weather events, malnutrition and impede, respiratory problems due to increase day by day for save human life we need to take action as well as for protecting health from climate change which is a global challenge that needs the action from all people. Health impacts of climate change can be experienced in the form of psychological impacts such as increased suicide rate, post-traumatic disorders following extreme weather events, loss of relationship and identity, substance abuse, and feelings of hopelessness and There's a lot we can also do in our daily life to prevent climate change including use of climate friendly transportation, save energy, go solar, harvest rain water, reduce waste and promote urban green spaces.

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## *Chapter-7*

### **SUSTAINABLE DEVELOPMENT: OUR COMMON FUTURE**

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#### **ABSTRACT**

Sustainable development is the key for overall well-being of the world. The word sustainable development has many definitions and the most admired definition had been coined by report of “Brundtland”, which defines sustainable development as “development that meets the needs of present without compromising the ability of future generations to meet their own needs”. To achieve sustainable development of profitability and for protecting planet by 2030, SDG, i.e., Sustainable Development Goals/Global Goals had been developed. There are 17 SDGs and have precise targets for each. Agenda 2030 (SDG) has five overarching themes, known as the five Ps: people, planet, prosperity, peace and partnerships, which span across the 17 SDGs. According to Taylor (2016), the three main concern of sustainable development are economic growth, environmental protection and social equality. Based on this, it can be states that the concept of SD rests, essentially, on three conceptual pillars. These pillars are “economic sustainability”, “social sustainability”, and “environmental sustainability”. The ultimate aim of SD is to attain a balance among environmental, economic and social sustainability, thus, making

these the pillars on which SD rests. The National Sustainable Development Strategy defines sustainable development as a targeted, long-term, comprehensive and synergic approach that understand the conditions and all facet of life at all levels, pacify biological, material, spiritual and social needs and interests of people, abolish or markedly reduces interference that damages or destroys conditions and forms of life, try not to burden the country, maintain resources, protect cultural and natural legacy. Despite ensuring sustainable development, is everyone's business, for that global, regional, national organizations as well as governments and civil society organizations are advised and likely to show ownership, leadership and citizenship.

*Keywords: Sustainable Development, SDGs, Sustainability.*

## **INTRODUCTION-**

Sustainable development can be defined as an approach to the economic development of a country without compromising the quality of the environment for future generations. Sustainable development is used to achieve a better and more sustainable future for everyone. The 2030 Agenda for Sustainable Development was adopted at the 70th General Assembly of the United Nations, in 2015, with the Resolution "Transforming Our World: The 2030 Agenda for Sustainable Development" (United Nations, A/RES/70/1, 2015). Agenda 2030 is the most ambitious global agreement the UN has ever reached, as it is an action plan for People, the Planet, and Prosperity. Agenda 2030 promotes the integration of all three dimensions of sustainable development social, environmental, and economic into all sector policies while promoting interconnection and the coherence of policy and legislative frameworks related to the Sustainable Development Goals (SDGs). Agenda 2030 is an action plan for People, the Planet, and Prosperity, which seeks to strengthen world Peace and implement it through the Partnership of all countries and stakeholders. These five thematic objectives ("5 Ps") constitute the core of the "Agenda 2030". The "Agenda 2030" sets 17 Sustainable Development Goals (SDGs) and 169 targets and the purpose is to reduce poverty and achieve sustainable development on a global scale by 2030, with no one left on the sidelines. These are specific goals for the next 15 years, which focus on human dignity, regional and global stability, ensuring the "health" of our planet, just and resilient societies, and prosperous economies.

## **METHODOLOGY-**

The data has been collected through the secondary data (existing data on a certain research) research reports from different organizations. Here we used limited publications on sustainable development.

## **DISCUSSION-**

We can say that Sustainable development is largely about people, their well-being, and equity in their relationships with each other, in a context where nature-society imbalances can threaten economic and social stability. Because of climate change, its impacts, and its policy

responses will interact with economic production and services, human settlements, and human societies, climate change is likely to be a significant factor in the sustainable development of many areas (e.g., Downing, 2002). Simply stated, climate change has the potential to affect many aspects of human development, positively or negatively, depending on the geographic location, the economic sector, and the level of economic and social development already attained (e.g., regarding particular vulnerabilities of the poor, see Dow and Wilbanks, 2003). Because settlements and industry are often focal points for both mitigation and adaptation policy-making and action, these interactions are likely to be at the heart of many kinds of development-oriented responses to concerns about climate change. With regards to SDG “No hunger”, a study of the progress, linkages, and disconnects of India towards food security and nutrition was conducted by (Das, Sharma, and Babu 2018) and the study found that southern states are far better than their counterparts in the area of food security and nutrition. The study concluded by recommending reforms in coordination and approach for achieving 2030 targets of food security and nutrition. Concerning to the SDG of “Health and Well-being,” the child mortality rate of India under the age of five was studied by (Bora and Saikia 2018) based on secondary sources and found that the National Mortality rate and U5MR are 2.4times and double higher than the targeted rates. The study found that North Central and eastern India is way behind in their targets. To this problem of high child mortality, the study conducted by (V Kancherla and Oakley 2017) described the way of reducing Child mortality by controlling birth defects. A similar study by (V Kancherla and Oakley 2016) (Vijaya Kancherla and Oakley Jr. 2018) mentioned about total prevention of folic acid-preventable Bifida and Anencephaly would reduce Child Mortality in India. Wang (2016) opines that proper human resource management is another important principle of SD. It is the people who have to ensure that the principles are adopted and adhered to. It is people who have the responsibility to utilize and conserve the environment. It is people who have to ensure that there is peace. This makes the role of human resources in the quest for SD critical. It’s high time to implement that human knowledge and skill in caring for the environment, economy, and society for the growth and development our country.

## **CONCLUSION**

Sustainable Development has given much attention in the academic sector, governance, planning, and development intervention space. Sustainable development should provide a solution in terms of meeting basic human needs, integrating environmental development and protection, achieving equality, ensuring social self-determination and cultural diversity, and maintaining ecological integrity. Sustainable Development Goals focused on a complex global situation, such as population growth, hunger and poverty, wars and political instability, and further degradation of the environment. Many countries are not even close to sustainable development and the gap between developed and under developed countries have deepened. Fundamental constraints of the implementation of the concept of sustainable development are the degree of socio-economic development that many countries have not yet achieved, associated with a lack of financial resources and technology, but also the diversity of political and economic

goals on a global scale. It's high time that Eco-activists and development activists put aside their disparity and unite under the banner of sustainable development to confront the endless obstacles facing us today.

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## Chapter 8

### **LEGISLATIVE FRAME FOR ENVIRONMENT PRESERVING : YAGYA'S – HAVANA'S ITS IMPORTANCE AND NECESSITY**

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#### **ABSTRACT**

Various types of Yagya's and Havan have been described in Indian texts, which have auspicious effect not only on the person but also on the atmosphere. Since time immemorial, there has been a tradition of performing Havan-Yagya in Sanatan culture for happiness and good luck and for the relief of suffering. At present, the environment will be purified by performing Havan-Yagya with medicinal Havan material, while the infection of germs and bacteria will also be destroyed. Many scientists and religious leaders have told the amazing benefits of performing Havan Yagya's to control epidemics and to purify the environment. The places where Havan is performed, it not only has a positive effect on the people present there, but due to the destruction of germs and viruses present in the environment, along with the environment, the human body also remains healthy. Because the fire and its smoke produced by the burning of Herbs, Pure Ghee, wood of Sacred trees, Camphor, Jatamasi, Clove, Guggul, Kalmegh, etc. used in the Havan Yagya's, not only purify the atmosphere, but also Similarly negative powers also run away. It is believed that by performing Havan once, the house can be kept free from any type of virus for a week. Which is a very important component from the point of view of Environmental cleanliness.

*Keywords : Havana's, Yagya's, Environment, Preserving*

#### **INTRODUCTION**

Since Ancient times, there has been a tradition of performing Havan-Yagya for happiness, good luck and peace in Sanatan culture. Yagya's was performed by Agni, the god of the earth. It is fire that takes the oblations to the deities. The fire of Yagya's and Havan has

been considered the main of God. Whatever sacrifices are offered in this, are actually Brahmabhoj. Yagya's and Havan were performed for Knowledge, Guest hospitality, Fulfilment of wishes or to pacify Ghosts and Spirits. It is believed in the scriptures that through havanYagya's, man had to express his gratitude to the ancient scholars and sages. Tarpan, Shradh rituals were performed for the peace of the dead ancestors. These havan Yagya's were organized to please the deities for the attainment of physical comforts, to satisfy the destructive forces, to satisfy the ghosts and spirits, to serve the visiting guests and to make the environment beautiful.<sup>1</sup> On the other hand, by performing Havan-Yagya with medicinal Havan material, the environment will be purified, while the virus infection will also be destroyed. Many scientists and religious leaders have told many wonderful benefits of performing Havan Yagya's to control epidemics and to purify the environment. The people present at the place where Havan is performed have a positive effect on the energy and smoke generated from the Havan. At the same time, the environment is also purified by the destruction of germs and viruses present in the environment. Due to which the human body remains healthy. Because the fire and smoke produced by the burning of the herb-rich havan material, Pure Ghee, Wood of sacred trees, Camphor etc., used in Havan, not only purifies the environment, but also negative forces run away. It is believed that by performing Havan once, the house can be kept free from any type of Virus for a week. Therefore, even from the scientific point of view, Havan and Yagya's are very beneficial for both Man and Nature.

### **TYPES OF HAVAN:**

In Hindu tradition, five types of Havan or Yagya's have been described-

1. Brahma Yagya's
2. Dev Yagya's
3. Pitru Yagya's
4. Bhut Yagya's
5. Atithi Yagya's<sup>2</sup>

Components of Havana's material: Sesame, Barley, Rice, Sugar, Cow's ghee, five Dry fruits, with this you can perform Havana's daily. Some herbs can be mixed together like:- Giloy, Nutmeg, Brahmi, Agar, Tagar, Indra Barley, White Sandalwood, Red Sandalwood, Jatamasi, Shankhpushpi etc. There is a proportion of sesame, barley, rice and sugar. It is like this – Half barley of sesame, half rice of barley, half sugar of rice. This is how the ratio of the main components occurs. The ingredients keep changing according to the type of Yagya's Havan.

### **TYPES OF HAVYAS (SACRIFICIAL LIQUIDS):**

Indian climate is characterized by heterogeneity. Which is divided into summer, autumn and rainy season. In each season there is a different type of atmosphere in the sky. In which there is presence of cold, heat, humidity, heaviness of air, lightness, dust, smoke, snow etc. Due to which the sequence of generation, growth and destruction of different types of germs goes on, so sometimes the atmosphere is healthy and sometimes it becomes unhealthy. Such medicines

are used in Havan Yagya's to remove such distortions and to create a favourable environment. Which can serve this purpose well. <sup>3</sup> Home material or Havan Samagri is the combustible material which is put in the fire of Yagya's Havan with mantras.

1. **SCENTED:** Saffron, Agar, Tagar, Sandalwood, Cardamom, Nutmeg, Mace, stick, Camphor, Kachri, Balchhad, Pandi etc.
2. **AFFIRMATIVE FACTORS:** Ghrit, Guggul, dry Fruits, Barley, Sesame, Rice, Honey, Coconut etc.
3. **SWEETS:** Sugar, Dates, Grapes etc.
4. **DISEASE KILLER:** Giloy, Nutmeg, Somvalli, Brahmi, Tulsi, Agar, Tagar Sesame, Indra Barley, Amla, Malkangani, Hartal, Tejpatra, Priyangu, Kesar, White Sandalwood, Jatamasi etc. The above four types of things should be used in Havan's.<sup>4</sup>

### **BENEFITS OF HAVAN-YAGYA'S:**

1. All the germs and bacteria present in the house are destroyed and the house is purified.
2. All the diseases of the body are destroyed by performing by Havan.
3. The amount of oxygen in the atmosphere increases.
4. Havan is very beneficial in the purification of the soul.
5. There is communication of positive energy in mind and brain.
6. Havan is also beneficial in getting rid of air pollution.
7. It is auspicious for warding off evil and for getting desired results. <sup>5</sup>

**PREVENTION OF DISEASES BY HAVANA'S-YAGYA'S :** See from this verse how Havan was used to cure headache or pain.

*Shweta Jyotishmati Chaiv Haritalam Manahshila I*

*Gandhaashcha Gurupatraadya Dhoomam Murdhavirechanam II*

That is, by performing Havan of Aparajita, Malkangani, Hartal, Mansil, Agar and Tejpatra medicines, Shiro Virechana is done, but now this medical method has almost become extinct. A look at some diseases and the Havan Samagri used for their destruction

1. **Diseases of the head** – Brahmi, Conch flower, Jatamasi, Agar, honey, Camphor, yellow Mustard for Headache, Depression, Excitement, Hysterical epilepsy etc.
2. **For gynaecological diseases, vat bile, chronic fever:** Bel, Sheonak, Ginger, Nutmeg, Nirgundi, Kateri, Giloy, Cardamom, Sugar, Ghee, Honey, Semal, Shisham
3. **To strengthen men:** White sandalwood powder, Agar, Tagar, Ashwagandha, Palash, Camphor, Makhana, Guggul, Nutmeg, Cinnamon, Basil leaves, Clove, Big cardamom, Gola.
4. **For stomach and liver diseases:** Bhringraj, Amla, Bel, Harad, Apamarg, Gular, Durva, Guggul, Ghee, Cardamom
5. **For breathing diseases:** Van Tulsi, Giloy, Harad, Khair Apamarg, Black Pepper, Agar, Tagar, Camphor, Cinnamon, Honey, Ghee, Ashwagandha, Aak, Eucalyptus <sup>6</sup>

### **SCIENTIFIC BASIS :**

The oblations that are offered in Yagya's, in that fire i.e. high temperature, the organic

elements get burnt and the inorganic remains remain. Which are of two types.

1. Many complex chemical compounds are broken down into simple or simpler forms.
2. Some simple and complex react to form more complex compounds. All these along with the smoke of Yagya's and Havan enter the body through breath and skin and make it healthy.

### **ALKALINES ARE BENEFICIAL :**

All plants contain some oily substance. Which are called alkaloids in scientific language. Today scientists are making many new medicines from different types of plants by researching these alkaloids. When these plants are burnt in Yagya's or Havan. So these alkaloids fly with the smoke and stick to your body and are inhaled and the smoke is directly effective in the human body and this method is cheaper and more durable than medicines. Means, not only by performing Havan but also by participating in Havan and its smoke, you can avoid various diseases and make your body healthy. <sup>8</sup>

### **SMOKE PURIFIES THE ATMOSPHERE:**

A research conducted by the National Institute of Botanical Research (NBR) has revealed that the harmful bacteria present in the air are destroyed up to 94% by the smoke rising during Yagya's and Havan. At the same time, its smoke purifies the atmosphere and this reduces the possibility of spreading the disease to a great extent.

### **IT IS ALSO BENEFICIAL FOR FARMING:**

It has been found in the research that the smoke of Havan and Yagya's remains in the atmosphere for 30 days and during this time poisonous germs do not grow. Smoke not only has a good effect on human health, but it has also proved to be very effective in agriculture. The germs present in the fields are destroyed by its smoke.

### **FOR CORONA VIRUS :**

Havan - Yagya's are very effective methods of prevention and treatment of corona virus or any other type of virus. This purifies the environment and increases life expectancy.

### **DAILY BENEFITS OF PERFORMING HAVAN YAGYA'S:**

If pure cow's ghee is used daily in Havan Yagya's, special Havan material should be prepared by mixing the following medicines in equal quantity. In which Agar, Tagar, Giloy, Tulsi, jatamasi, Hauber, Neem leaf, Neem bark, Kalmegh, Nutmeg, Mace, Agyaghas, Bitter

Bach, Nagarmotha, Sugandhabala, Clove, Bhimseni Camphor, Cedar, Soft sugar, white sandalwood, Daru turmeric Offer at least five offerings to the Gayatri Mahamantra

*Om Bhurbhuvah Swaha . Tatsaviturvarenya* □  
*Bhargo Devasya Dhimahi. Dhiyo yonah prachodayat* □□  
and three offerings to the Mahamrityunja mantra.<sup>9</sup> Our sages have called Mahamrityunja Mantra

*Om Trimbakam Yajamahe Sugandhi Pushtivardhanam* □  
*Urvarukamiv Bandhananamrityormukshiya Maamritat* □□  
as Mrit Sanjeevani Mahamantra.

It's chanting has a positive effect on health and the fear of premature death ends. Indian Council of Medical Research (ICMR) also conducted research on its effect on patients of Ram Manohar Lohia Hospital, Delhi.<sup>10</sup>

There is also a belief that if the planets sitting in a person's birth chart are giving inauspicious effects, then the auspicious effects of the planets will start to be seen as soon as they perform ritual sacrifices. By resolving the day related to the planet that gives pain, keeping eleven or twenty fasts, and then giving completeness in the Havan-Yagya's, Disease, Sorrow, Suffering and Obstacles are removed. After the completion of Havan-Yagya's, donating money, food, fruits, clothes, life-useful things according to devotion brings peace to the planets. During Havan-Yagya's, all our senses are activated by drinking water in a copper vessel and positive energy is generated in the body, keeping the mind and body healthy.<sup>11</sup>

## **CONCLUSION AND SUGGESTION:**

On the basis of scientific research, it can be said that the germs and viruses present in the environment are eliminated to a great extent by the material used in Havan-Yagya's. Which is beneficial in view of human health, but unbalanced use of Havan materials can also prove to be injurious to health. Therefore, it is essential to use balanced Havan Samagri while performing Havan-Yagya's. There are some misconceptions about Havan Yagya's. Not following them, only for the cleanliness of the healthy environment, the purpose of Havan-Yagya's can be done in homes, school premises, business premises. There is heterogeneity in the Indian climate, so it is necessary to organize Havan-Yagya's at a certain interval only. Organizing Havan-Yagya's is costly from the economic point of view. Most of the middle class are also deprived of this event. The simple solution to this is that instead of using the entire Havan-Yagya's material, the environment can be purified by organizing a Havan-Yagya's using only the essential ingredients. For example, guggul, ghee, rock salt, clove, camphor can be used in the fire of upala's of cow dung. Which will prove to be very useful in fighting the epidemics spreading in Modern global era.

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# Chapter 9

## A REVIEW ON BIOLOGICAL APPLICATIONS OF SCHIFFBASE LIGANDS AND THEIR METAL COMPLEXES

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### ABSTRACT:

Schiff bases are privileged ligands that are synthesised from the condensation of primary amine with carbonyl group. Schiff bases have been extensively studied over the past decades as Schiff bases provide a potential site for biochemically active compounds. Schiff bases have a variety of biological activities, including antioxidant, anti-inflammatory, antiviral, and anti-diabetic properties. Schiff bases also play an important role in catalysis, biosensors, anticorrosion, and as memory storage devices in electronics. This review summarises the biological activities of Schiff bases and their metal complexes. Schiff bases are potential antibacterial, antifungal, and anticancer drugs, and when administered as their metal complexes, biological activities of these complexes is enhanced in comparison to the free ligand. These promising results are encouraging for inorganic as well as bio-inorganic chemists.

*Keywords: Schiff base, metal complexes, biological activity, antibacterial, antifungal, anticancer.*

### INTRODUCTION

Substances that contains an azomethine group ( $-\text{HC}=\text{N}-$ ) are called as Schiff base. Hugo Schiff initially reported them in 1864; they are condensation products of ketones (or) aldehydes with primary amines. [1] Coordination chemistry has greatly benefitted from the introduction of Schiff base ligands. [2] Schiff bases bonding ability depends on the electronegativity, steric factor, and the type of the atoms that serve as coordination site, such as N, O and S.[3,4]. Due to their capacity to form stable complexes with metal ions, Schiff base ligands are extremely important in chemistry, particularly in the synthesis of Schiff base complexes. [5,] Along with other biological uses, Schiff bases are essential in several applications as antibacterial and antifungal agents. [6] Schiff bases' azomethine or amine groups are crucial for demonstrating outstanding biological activity. [7] A lot of interest has been paid to Schiff bases and their metal complexes due to their biological activities, which include DNA binding and cleavage [8, 9], antifungal [11, 12], antibacterial [15, 16], antidiabetic [18, 19], antitumor [20, 21], anticancer [22, 23], and anti-

inflammatory properties [24]. Because of their wide biological activity, Schiff bases and their metal complexes have recently attracted a lot of attention. The biological characteristics of metal coordination complexes, particularly transition metal complexes 3d and 4d, have received much research. Studying the biological effects of macrocyclic Schiff base ligands and their metal complexes is the focus of the current review paper.

When searching for potential chemotherapeutic medicines to treat disease, the chemistry of Schiff base-metal complexes has captured the attention of scientists. Schiff base ligands are known as "fortunate ligands" because of how simple it is to develop and make them. They have azomethine derivatives, which are necessary for biological activity [25,26,27]. The present paper summarises the potential antibacterial, antifungal, and anticancer actions of Schiff base ligands and the associated metal complexes used in medicinal applications.

## 1. BIOLOGICAL APPLICATIONS

### 1.1. ANTIBACTERIAL:

Pt(+4) and Pd(+2) complexes with four unsymmetrical tetradentate Schiff base ligands ( $H_2L^1$ ,  $H_2L^2$ ,  $H_2L^3$  and  $H_2L^4$ ) derived from aromatic 2-hydroxy aldehyde in an ethanolic medium were prepared (*Hegazy et al. 2012*) and characterized by magnetic susceptibility, thermogravimetry, elemental analyses, melting point, differential scanning calorimetry (DSC), IR, electronic spectral measurements and experiment suggest that metal complexes have square planar geometry. Antibacterial activity of the ligand and their metal complexes were tested in vitro against 10 human pathogenic bacteria and antibacterial activity were compared with that of chloramphenicol a standard antibiotic for bacterial strains<sup>28</sup>.

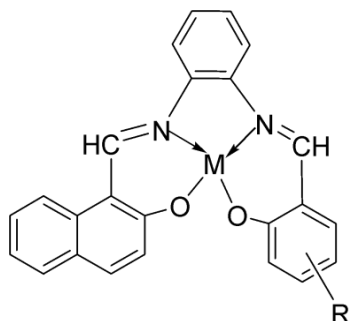


Fig.1: Schiff base metal complexes where M= Pt (IV), Pd (II) and R= 5-Cl,  $H_2L^1$ ; R= 5-NO<sub>2</sub>,  $H_2L^2$ ; R= 3-OCH<sub>3</sub>,  $H_2L^3$ ; R= H,  $H_2L^4$ .

Vanadium (V) complexes of Schiff bases (HDAA) (fig.2) and (EDAA) (fig.3) were prepared by refluxing ligands with  $[VO(acac)_2]$  in alcoholic medium (*Pawar et al. 2010*) and characterized by microanalytical analysis and UV,  $H^1$ NMR, IR, spectral data suggest the square planar geometry. The synthesized ligands and complexes show antibacterial activities against *B. licheniformis*, *S. aureus* and *M. luteus* ( gram positive ) and *E. coli* ( gram negative ).<sup>29</sup>



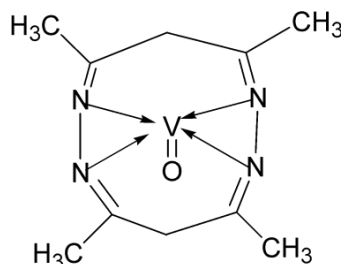


Fig.2: Oxovanadium complex of ligand HDAA

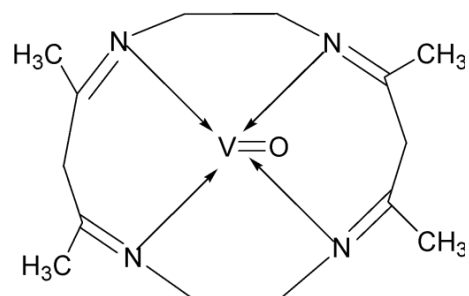


fig.3: Oxovanadium complex of ligand EDAA

Two new Cu (+2) schiff base complexes  $[Cu(L)_2](ClO_4)$  (1) and  $[Cu(L)_2NO_3] NO_3$  (2) (where L= 4,5,9,13,14,pentaaza-benzo[b]triphenylen) were synthesized and characterized. Nano structure compound of complex (1) and complex (2) were prepared by sonochemical and solvothermal methods respectively and characterized by physicochemical , XRD, and SEM techniques . The complex (1) is moderately active against two gram positive bacteria ( *B. anthracis* , *S. aureus* ) and weakly active against *S. pyogenes*. The complex (2) have better activity against three examined bacteria than complex (1)( fig. 4) and both nano complexes antibacterial activities are similar with complex (2)(fig.5)<sup>30</sup>.

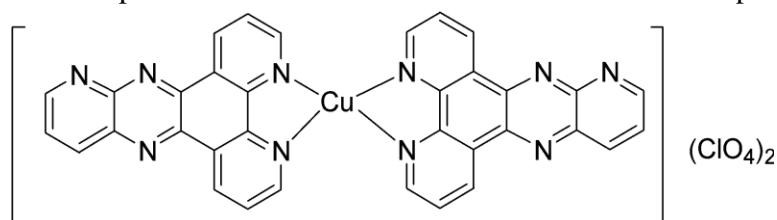


Fig.4: Schiff base complex (1)

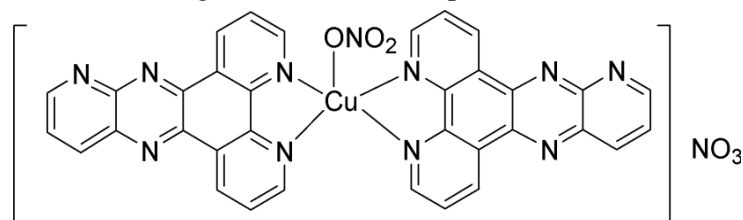
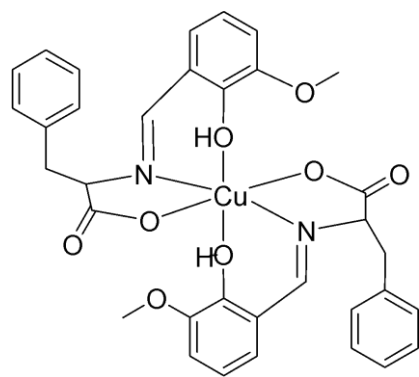


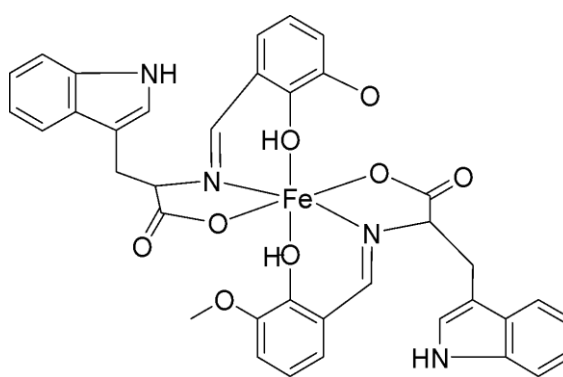
Fig.5: Schiff base complex (2)

Schiff base ligand and their novel nano size Fe (+2) and Cu (+2) complexes (Fig 6 and 7.) were synthesized (*Rahman et al. 2015*) and characterized by elemental analysis, thermal analysis (TGA),  $H^1NMR$ ,  $C^{13}NMR$ , IR, UV-visible, molar conductance, magnetic susceptibility and SEM. The experimental result suggests Schiff base metal complexes possess octahedral geometry. The Schiff base ligand and their metal complexes tested against *B. subtilis*, *Micrococcus luteus* (gram positive) and *E. coli* (gram negative). The metal complexes exhibit a stronger antibacterial activity than that of free Schiff base ligand<sup>31</sup>.



MSPCu

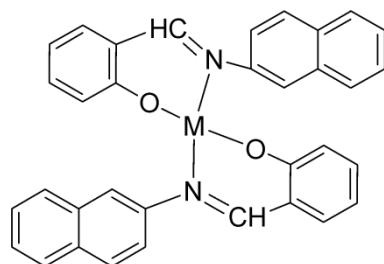
Fig.6: Schiff base metal complex of Cu



MSTFe

Fig.7 schiff base metal complex of Fe

The Schiff base ligand (NABSA) and their Co (+2), Ni (+2) and Cu (+2) complexes were synthesized and characterized by conductance measurements, magnetic moment, thermal analysis (TGA/DTA), EPR, FT-IR and electronic spectroscopy. The free ligand and their metal complexes were screened for their antibacterial activity against *S. aureus*, *B. subtilis* (gram positive) and *Pseudomonas aeruginosa*, *E. coli* (gram negative). The metal complexes exhibit more antibacterial activity than synthesized ligand.<sup>32</sup>



M = Co(+2), Ni(+2)

Fig.8: Schiff base metal complexes

Macrocyclic Schiff base ligands and their metal complexes (fig.9) have been synthesized (Parsae et al. 2017) and characterized by spectral methods, elemental analysis, TGA, magnetic moment techniques. NiO nanoparticles prepared by thermal decomposition method and characterized by FT-IR, SEM, and powder XRD. In vitro antibacterial activity for Schiff bases and their metal complexes have been screened against two gram positive and two gram negative bacteria. The Nickel (+2) complexes exhibit more activity than free Schiff base.<sup>33</sup>

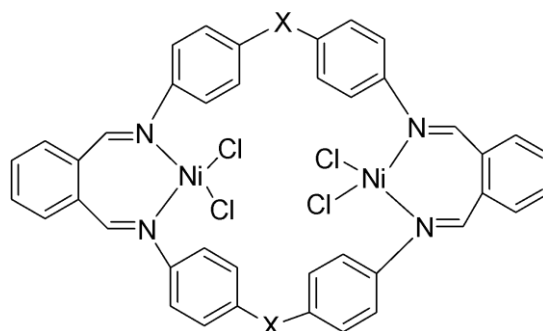


Fig. 9: Schiff base metal complex

A series of mononuclear Ni(II), Cu(II), and Zn(II) complexes with ONNO donor salentype Schiff base ligands were synthesised by Hadi Kargar et al. in 2021. These complexes were made from various 3, 5-dihalosalicylaldehydes with polymethylenediamines of varying chain lengths, and they were characterised using a variety of spectroscopic and analytical methods. By testing them against two strains of Gram positive (*Staphylococcus aureus* and *Bacillus cereus*) and two strains of Gram negative (*Escherichia coli* and *Pseudomonas aeruginosa*), the antibacterial properties of the synthesised ligands and their related complexes were elaborated. The measurements of the zones of inhibition revealed that metal chelates are just slightly more efficient than free ligands.<sup>34</sup>

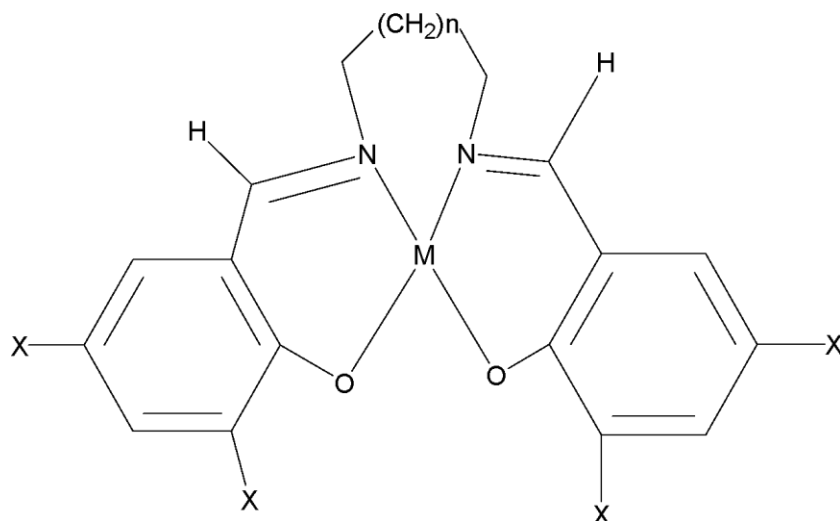


Fig:10 Schiff base metal complexes where X= Br, I and M = Zn,Cu, Ni

Two new nano-sized Schiff base complexes [M(L)] (fig.11) were synthesized by ultrasonic irradiation (*Tohidiyan et al. 2016*) and characterized by elemental analysis, FT-IR, <sup>1</sup>H-NMR, UV-VIS, fluorescence, FESEM and molar conductivity. In vitro antibacterial activities of the metal complexes screened against *S.aureus*, *B.cereus*, *M.luteus*, *E.faecalis* (gram positive) and *E.coli*, *pseudomonas-sp*, *P.aeruginosa*. The experimental data suggested that Cu (+2) complex exhibit higher antibacterial activity than the Zn (+2) complex.<sup>35</sup>

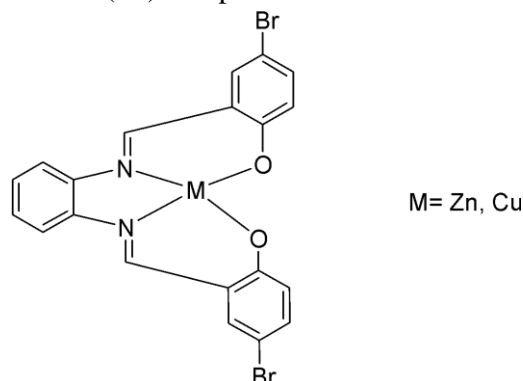


Fig.11: Nano-sized Schiff base metal complexes

Schiff base ligand (HL) and its Mg (+2), Ca (+2) and Ba(+2) metal chelates were synthesized and characterized by elemental analysis, spectroscopic techniques, SEM. Schiff base ligand and their metal chelates were screened against *B.subtilisa*, *Streptococcus pneumonia*, *S. aureus* and *E.coli*, *P.solanarium*. Experimental data suggested that synthesized compounds exhibited variety degree of antimicrobial activity.<sup>36</sup>

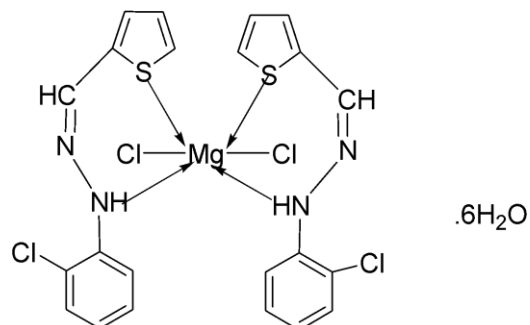


Fig. 12:  $[Mg(HL)_2Cl_2] \cdot 6H_2O$  Schiff base complexes.

The Schiff base ligands ( $H_2L^1$  and  $H_2L^2$ ) their transition metal complexes (fig. 13) were synthesized (*Salem et al. 2012*) and characterized by elemental analysis, <sup>1</sup>HNMR, IR, UV-Vis, TGA, ESR, fluorescence spectroscopy and magnetic susceptibility. The antibacterial activity of the ligands and their Mn (II) and Cu (II) complexes have been screened against 5 microbial strains, *S.aureus*, *M.luteus* and *B.subtilis*, *E.coli* and *pseudomonas-sp.* The experimental data indicated that the ligands have no biological activity for all tested strains and Mn (II) complexes of Schiff base  $H_2L^1$  exhibited antibacterial activity for all tested strains.<sup>37</sup>

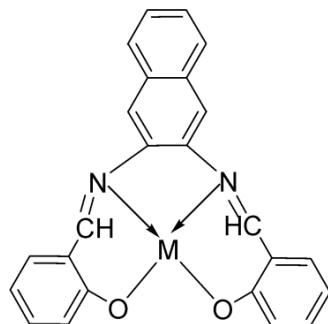


Fig.13: Schiff base metal complexes ( $ML^1$ ) where M= Mn (II), Cu (II) and Cd (II)

Under the application of microwave irradiation technique Schiff base were synthesized (fig.14) and characterized by spectroscopic data. The in vitro antibacterial activity of the synthesized compounds tested against *B.subtilis*, *S.aureus* and *E.coli* bacteria. Most of the compounds showed significant antibacterial inhibitory activity.<sup>38</sup>

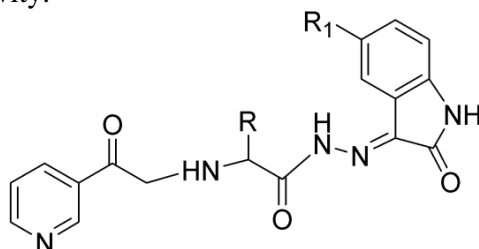


Fig. 14: Novel Isatin schiff base

New monomeric cobalt and cadmium complexes with Schiff base ligands were synthesized (fig.15) and characterized by spectroscopic and physico-chemical analysis.

Biological activity of the Schiff base ligands and their metal complexes against *Bacillus* (G+) and *Pseudomonas*(G-) revealed that the ligands have higher antimicrobial activity than their Co(+2) and Cd (+2) complexes.<sup>39</sup>

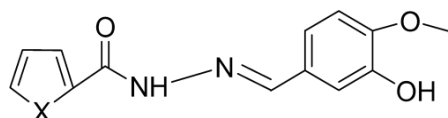
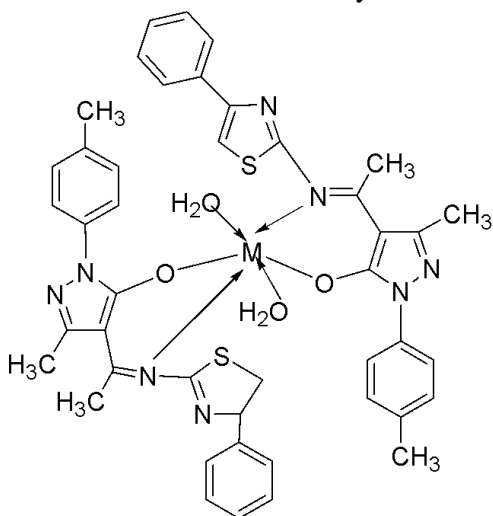


Fig.15: Schiff base ligands ( L<sup>1</sup> and L<sup>2</sup> )

Novel Schiff bases and its 3d metal complexes (fig. 16) were synthesized and characterized by physical and spectral techniques. The complexes and ligands have been screened in vitro for their antibacterial activity against *E.coli*, *S.aureus* and *B.subtilis*. All the metal complexes shows moderate antibacterial activity.<sup>40</sup>



Where, M= Mn(+2), Fe(+2), Co(+2), Ni(+2) ,Cu(+2)

(Fig . 16: Metal complexes of ligand L )

A series of new azomethine derivatives (fig.17) were synthesized (*Iqbal et al. 2007*) and characterized by <sup>1</sup>H-NMR, <sup>13</sup>C-NMR, MS and elemental analysis. The compounds were screened against *S.aureus* and *E.coli* bacteria. Some of all examined compounds show good antibacterial activity almost equal to that of Ciprofloxacin used as standard.<sup>41</sup>

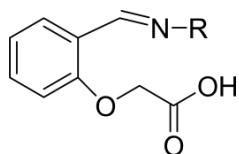


Fig.17: Azomethine derivatives

Five new metal complexes of 2N-salicyledene-5-(p-nitrophenyl)-1,3,4-thiadiazole HL with metal ions VO(II), Co(II), Rh(II),Pd(II) and Au(II) had been successfully synthesized in alcoholic medium (*Yousif et al. 2017*). The synthesized complexes have been characterized by micro elemental analysis, magnetic susceptibility, conductivity measurements, FTIR, UV-Vis, <sup>1</sup>HNMR, <sup>13</sup>CNMR and mass spectroscopy. On the basis of above studies the geometry of metal complexes has been suggested. The free ligand and its metal complexes had been tested preliminary in-vitro against *S.typhi*, *S.aureus* and *E.coli*. The experimental results indicated that

the metal complexes had moderate activity against the tested bacterial strains and slightly higher than free ligand.<sup>42</sup>

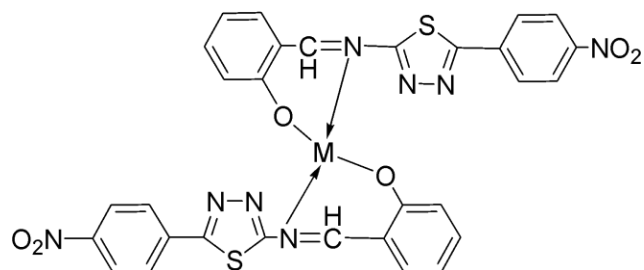


Fig.18: Schiff base metal complexes where M= Pd, Cu.

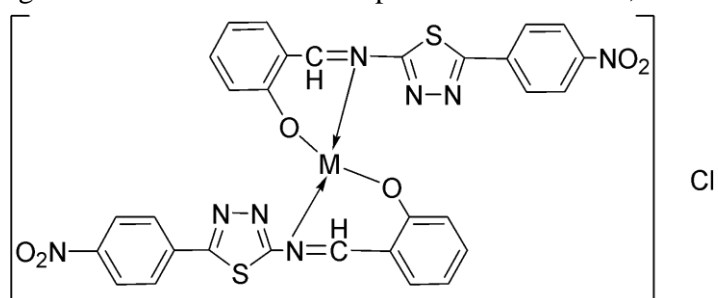


Fig.19: Schiff base metal complexes where M= Rh, Au

Azo-schiff base complexes of VO(II), Co(II), Ni(II), Cu(II) and Zn(II) (fig.20) were synthesized and characterized by elemental analysis, <sup>1</sup>HNMR, IR, UV-Vis, mass spectra, magnetic susceptibility measurement, EPR, molar conductance, CV, fluorescence, NLO and SEM. The in-vitro antimicrobial activity against *S.aureus*, *E.coli*, *S.enterica typhi*, *B.subtilis* was studied and compared with that of free ligand.<sup>43</sup>

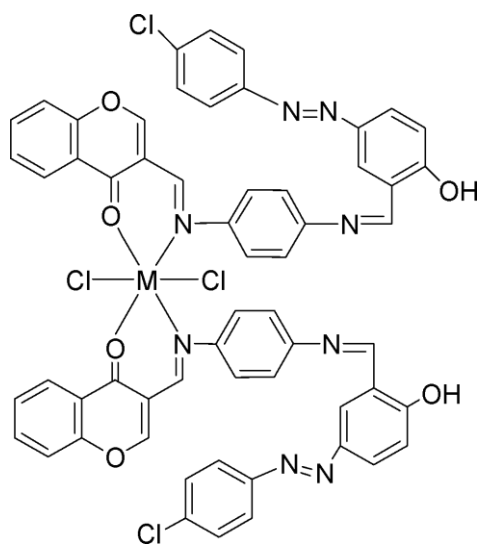


Fig.20: Proposed structure of metal complexes, where M= Co(II), Ni(II), Cu(II) and Zn(II).

Novel binuclear metal complexes  $[M_2(PymL)X_3]$  (fig. 21) synthesized (*Srivastva et al.2016*) by template condensation of schiff base (L) and characterized by physico-chemical techniques. Experimental data suggested octahedral geometry of metal complexes. The synthesized ligand and its metal complexes were evaluated for their antibacterial property by in-

in vitro antibacterial testing against *S.aureus*, *B.subtilis*, *E.coli* and *S.typhi*. The experimental results suggested that metal complexes exhibited more activity than the free Schiff base (L) against studied bacteria.<sup>44</sup>

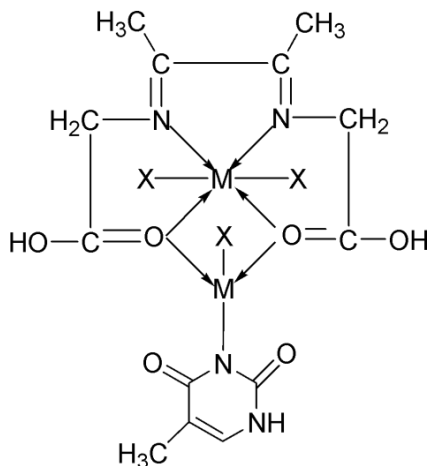


Fig. 21: Binuclear metal complexes  $[M_2(PymL)X_3]$  where  $M = Cu(II), Ni(II), Co(II)$  and  $Zn(II)$ ;  $X = Cl^-$  or  $CH_3COO^-$  and  $PymL = C_{13}H_{17}N_4O_6$

Tetradentate Schiff base of type (NNOO) and its metal complexes (fig. 22) have been synthesized (Al-Shemary *et al.* 2015) and characterized by physical and spectral techniques. The experimental data suggested that Cu, Ni, Hg have square planar and Co and Mn complexes have tetrahedral geometry and Schiff base ligand and its metal complexes show good biological activity against *S.aureus*, *Pseudomonas*, *Bacillus* and *E.coli*.<sup>45</sup>

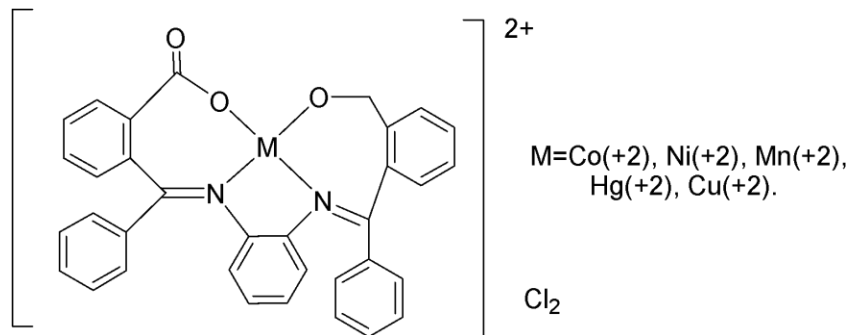


Fig. 22: The ligand metal complexes

Metal (II) complexes of Cu, Ni and Co with Schiff base derived from potassium 2-N(4-N,N-dimethylaminobenzylidene)-4-trithiocarbonate 1,3,4-thiadiazole (L) have been synthesized (Alias *et al.*, 2014) and characterized by metal analysis A.A, elemental chemical analysis C.H.N.S, thermal analysis TGA, FTIR, UV-Vis, conductometric measurements and magnetic susceptibility. The Schiff base ligand and its metal complexes have been screened for their antibacterial activity to assess their inhibiting potential against *P.aeruginosa* (gram negative) and *S.aureus* (gram positive) bacteria. The experimental data indicated the Ni(II) complex (fig. 23) have the higher rate in antibacterial activity than other complexes and free ligand when compared them with ampicillin as standard drug.<sup>46</sup>

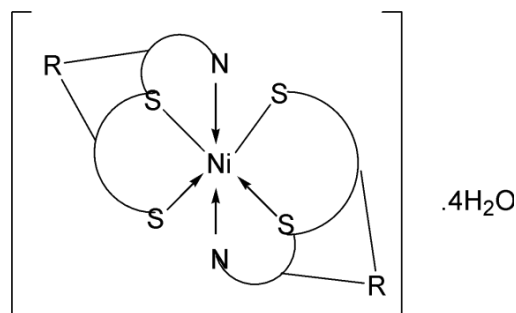


Fig.23: Suggested structure of  $[NiL_2].4H_2O$  complex

Metal complexes derived from 2,6- pyridinedicarboxaldehydebis(p- hydroxyphenylimine);  $L^1$ , 2,6- pyridinedicarboxaldehydebis(o-hydroxyphenylimine);  $L^2$ , (fig. 24) have been synthesized (Mohamed *et al.* 2006) and characterised. The complexes are found to have the formulae  $\{MX_2(L^1 \text{ or } L^2)\}.nH_2O$ , where  $M = Fe(II), Co(II), Ni(II), Cu(II)$  and  $Zn(II)$ ,  $X = Cl$  in case of  $Fe(II), Co(II), Ni(II), Cu(II)$  complexes and  $Br$  in case of  $Zn(II)$  complexes and  $n=0-$

2.5. The synthesized ligands and their metal complexes have been tested for their antibacterial activity against bacterial species, *E.coli*, *P.areuginosa*, *S.aureus*. The experimental data indicate that the metal complexes are more potent than parent ligands.<sup>47</sup>

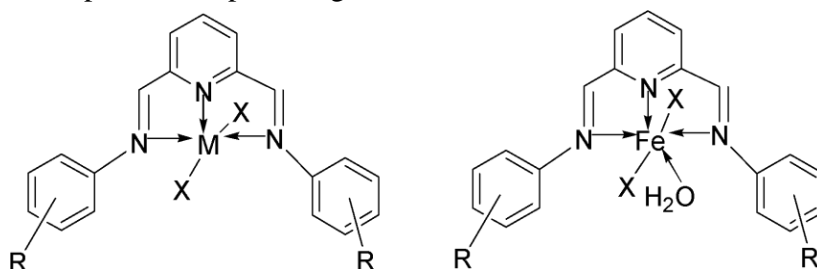


Fig. 24 : Structure of  $L^1$  and  $L^2$  complexes where  $M = Co(II), Ni(II), Cu(II), Zn(II)$  and  $L^1: R = o-OH.$ ,  $L^2: R = p-OH.$

Schiff base derived from cefadroxil and its metal complexes synthesized and characterized by physio-chemical and spectral techniques. Schiff base and its metal complexes screened against bacterial strain. The experimental results indicate the Schiff base metal complexes have better antibacterial activity than the free ligand and parent drug.<sup>48</sup>



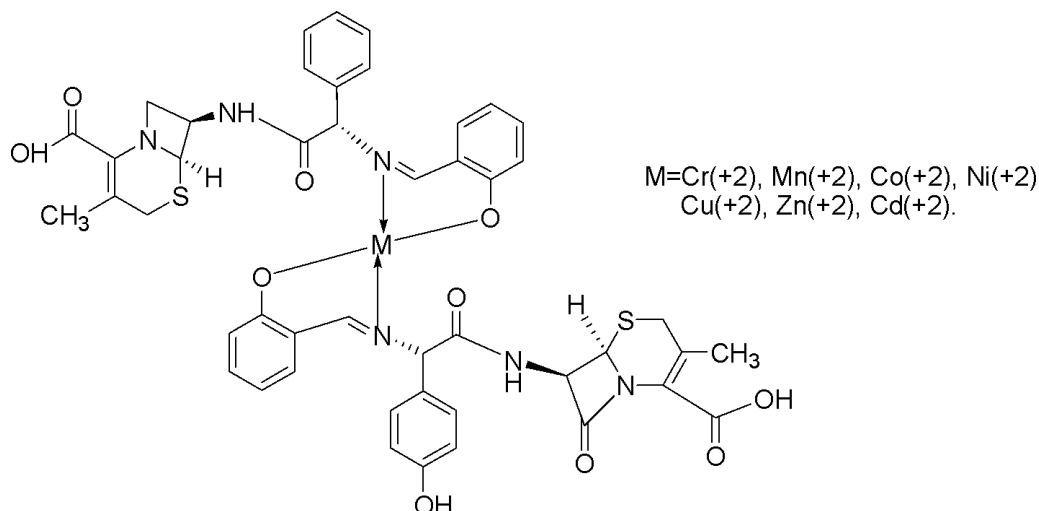


Fig. 25: Schiff base metal complexes

New open macrocyclic Schiff base ligands ( Fig. 26) were synthesized and characterized by LC-MS,  $^1\text{H}$ NMR, IR, spectral techniques. Synthesized macrocyclic ligands were tested against *S. aureus*, *E. coli*, *S. typhi*, *K.lebcella*. The result suggested that their antibacterial activity were found to vary from moderate to very strong.<sup>49</sup>

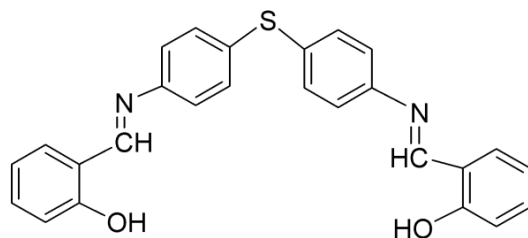


Fig . 26: Schiff base

A new macrocyclic Schiff base ligand and their metal complexes ( fig. 27) were synthesized ( *Ahmed et al. 2013*) and characterized by physico-chemical and spectroscopic methods . the free schiff base and its metal complexes were screened against *S. aureus* and *E. coli* . Metal complexes found more active than free Schiff base ligand and these metal complexes do not inhibit the activity of *P. Aeruginosa* bacteria.<sup>50</sup>

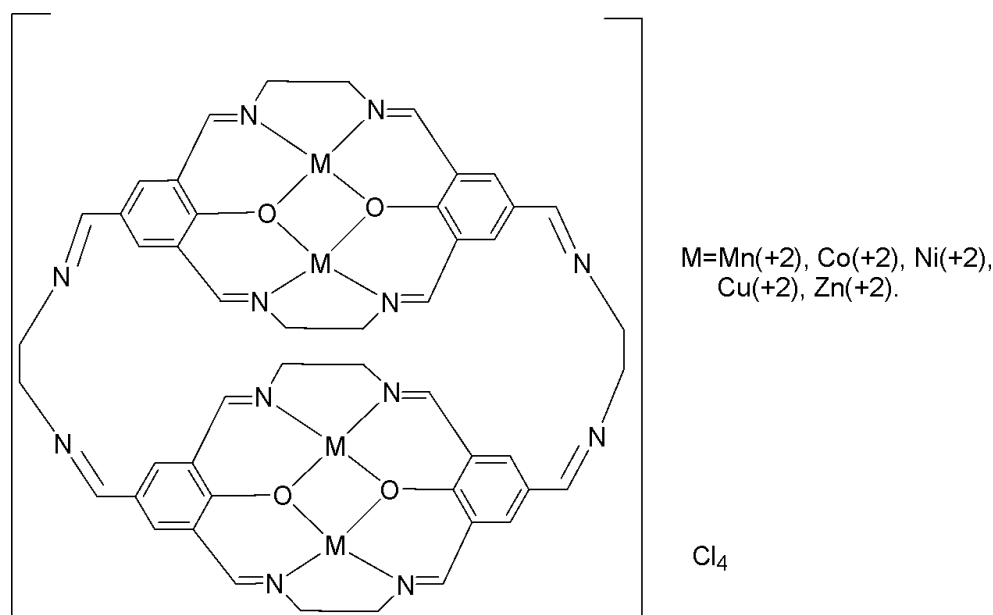


Fig. 27: Schiff base metal complexes

## 2.2 ANTIFUNGAL

Novel metal complexes of Cu (+2) with Schiff base were synthesized ( Fig. 28) and characterized by elemental analysis,  $H^1$ NMR, UV-VIS, magnetic susceptibility and powder XRD. On the basis of above studies, the octahedral geometry of the metal complexes has been suggested. The in vitro antifungal study of the compounds was screened against the fungi *Candida* sps, *A. niger* and *A. fumigates*. The experimental data indicates that the complex exhibits higher activity than the free ligand.<sup>51</sup>

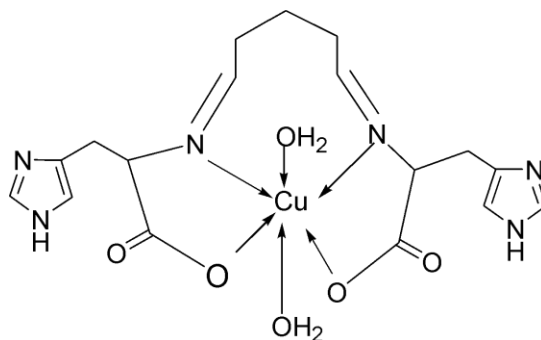


Fig. 28: Structure of Cu (+2) complexes

The dibasic tridentate Schiff bases and its Ni (+2) complexes ( fig. 29-30) have been synthesized ( *Hasan et al. 2016*) and characterized by spectral and physicochemical techniques. The metal complexes have considerable inhibition effect on mycelia growth against selected plant pathogenic fungi.<sup>52</sup>

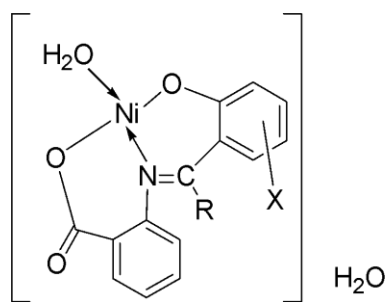


Fig.29: [NiL.H<sub>2</sub>O]. H<sub>2</sub>O complex

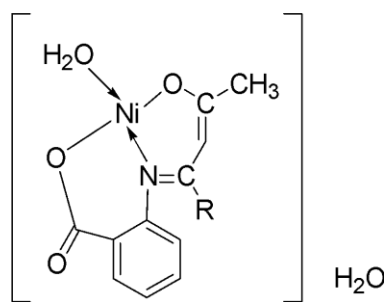


fig. 30: [NiL<sub>1</sub>.H<sub>2</sub>O]. H<sub>2</sub>O complex

Oxoaza-mixed macrocyclic complexes of Mg (+2), Ca (+2), Sr (+2) and Ba (+2) derived from macrocyclic ligand (*Bugalia et al. 2013*) and characterized by physical and spectral techniques. The synthesized complexes (fig.31) have been tested for antifungal activity against *M. gypseum* (ATCC 2819), *T. tonsurans* (ATCC 8475), *T. rubrum* (ATCC 296) and *M. fulvum* (ATCC 2837).<sup>53</sup>

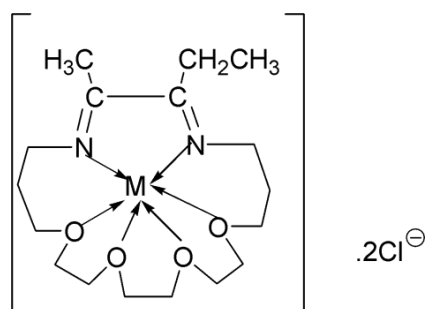


Fig.31: Schiff base metal complexes

New Co(II) and Ni(II) complexes of 12-membered macrocyclic Schiff base ligand containing thiosemicarbazone moiety as a part of ring have been prepared having general composition [MLX<sub>2</sub>] where M= Co(II), and Ni(II), L= 3,4,9,10-tetra-2-furanyl-1,2,5,6,8,11- hexaazacyclododeca-7,12-dithione-2,4,8,10-tetraene, X= Cl<sup>-</sup>, NO<sub>3</sub><sup>-</sup>, NCS (figure.32) have been synthesized and characterized. The antifungal activities of complexes have been examined against a number of pathogenic fungi. The complexes exhibited good antifungal activity.<sup>54</sup>

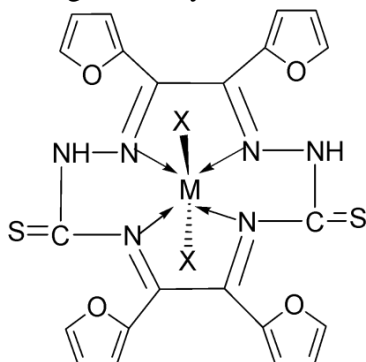


Fig.32 : Schiff base metal complexes

Zn(+2) complex of tridentate Schiff base ligand were synthesized and characterized by elemental analysis, molar conductance and spectral techniques . Antifungal activity of Schiff

base (fig. 33) and its metal complex (fig. 34) screened against *A. niger* and *C. albicans*. The activity of Schiff base become more effective when coordinate with metal ion.<sup>55</sup>

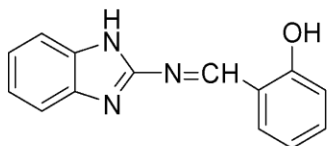


Fig. 33: Schiff base

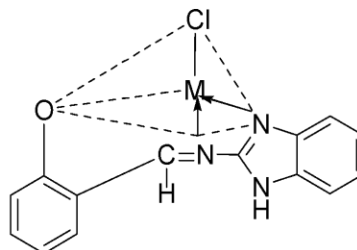


fig.34: structure of metal complexes

A new series of transition metal complexes (Fig. 35) have been synthesized from the Schiff base and characterized by physical and spectral data. Experimental data suggest that most complex have higher antimicrobial activity than the free Schiff base. Antifungal activity of synthesized complexes screened *A. flavus*, *A. niger* and *R. bataicala*.<sup>56</sup>

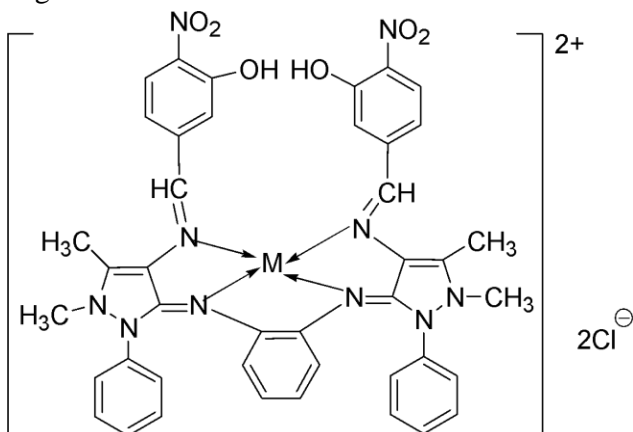
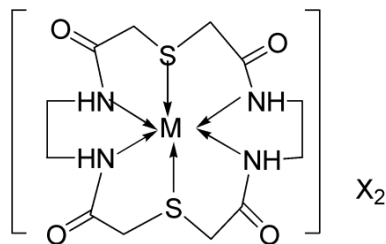


Fig. 35: Structure of the Schiff base complexes. Where M = Cu (+2), Ni(+2), Co(+2), Mn(+2), Zn(+2), Cd(+2), Hg(+2)

and VO(+4)

A new mixed thia-azo-oxamacrocyclic Schiff base and its metal complexes were synthesized (*Sheikh et al. 2013*) and characterized by spectral data and physical techniques. These metal complexes were also screened for their in vitro antimicrobial activity against fungal strain the antimicrobial study data suggested that the metal chelates exhibit a higher inhibitory effect than the free schiff base.<sup>57</sup>

Fig. 36: Schiff base metal complexes. Where, M=Co(+2), Ni(+2), Cu(+2), Mn(+2), and X=



Cl<sup>-</sup>, NO<sub>3</sub><sup>-</sup>.

Six Schiff bases have been synthesized and characterized by spectral methods. The synthesized compound examined *in vitro* for their anticandida activity. Compound (Fig. 37.) exhibited significant anticandida activity therefore, suggested as a promising and potential antifungal agent.<sup>58</sup>

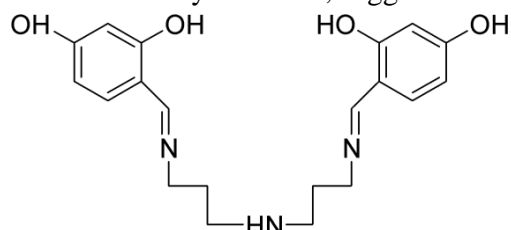


Fig.37 : Schiff base

A new series of macrocyclic tetradentate nitrogen donor ( $N^4$ ) ligand based 3d metal complexes (fig. 38).  $[M(C_{12}H_{20}O_8N_4)Cl_2]$  where,  $m=Co(+2)$ ,  $Cu(+2)$  and  $Ni(+2)$  were synthesized and screened them for their anticandidal activity by performing MIC along with ergosterol composition assay against *C. albicans*, *C. glabrata* and *C. tropicalis* respectively. The experimental result showed that the metal complexes have high killing activity than the ligand.<sup>59</sup>

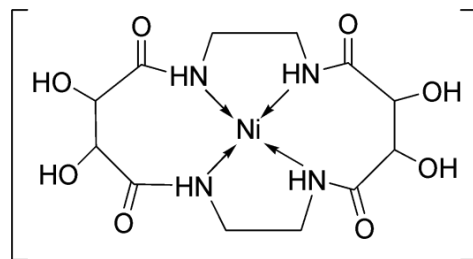


Fig. 38: Schiff base metal complex

1:2 complexes of  $Co (+2)$ ,  $Ni (+2)$ ,  $Cu (+2)$  and  $Zn (+2)$  with Schiff base ligand (indol-4- AAP) were synthesized and characterized by physicochemical and spectral methods. The experimental data suggested the octahedral geometry of synthesized complexes. The antifungal activity screened against *A. niger*, *A. flavous*, *C. albicans*. The result indicate that the metal chelates are more toxic than the free ligand, against the same fungi species.<sup>60</sup>

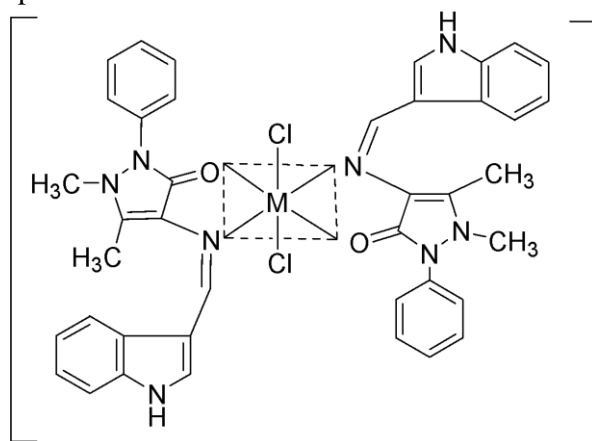
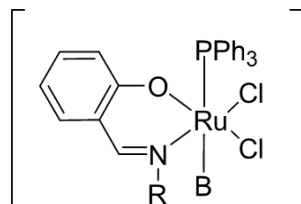


Fig.39: Proposed structure of Schiff base complexes of Co(+2), Ni(+2), Cu(+2), Zn(+2) .

Bidentate Schiff base ligands and its Ru (+2) complexes were synthesized and characterized by analytical, IR, electronic,  $^1\text{H}$ NMR and  $^{13}\text{P}$ NMR spectral studies. The Schiff base and new complexes were screened in vitro to evaluate their antifungal activity against *A. flavus*.<sup>61</sup>

Fig. 40: Schiff base ruthenium (+2) complex where, B= PPh<sub>3</sub>, Py, Pip and R= Ph, 2-MeC<sub>6</sub>H<sub>4</sub>,



3-MeC<sub>6</sub>H<sub>4</sub> or 4-MeC<sub>6</sub>H<sub>4</sub>.

New N<sub>2</sub>O<sub>2</sub> donor type Schiff base and its metal complexes were synthesized and identified by physical and spectral methods. The in vitro antifungal activities of the compounds were screened against *A. niger*, *R. stolonifer*, *A. flavus*, *C. albicans*, *T. harizanum* and *R. bataicola*. All the metal complexes exhibited higher antifungal activities than the free Schiff baseligand.<sup>62</sup>

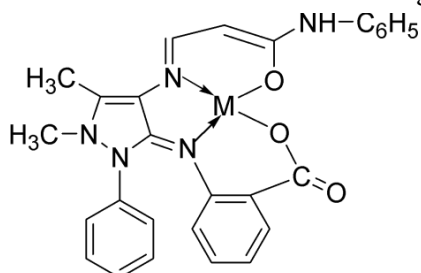


Fig 41: Schiff base metal complexes where M= Cu(II), Ni(II), Co(II), Mn(II), Zn(II), VO(IV), Hg(II) and Cd(II).

Bidentate Schiff base ligand and its 3d metal complexes have been synthesized (*Malik et al.2013*) and characterized by physiochemical and spectral studies. The pure drug synthesized ligand and its metal complexes were tested for their antifungal activity against *A. flavus* and *A. niger*. Metal complexes showed higher activity as compared to free ligand and standard drug.<sup>63</sup>

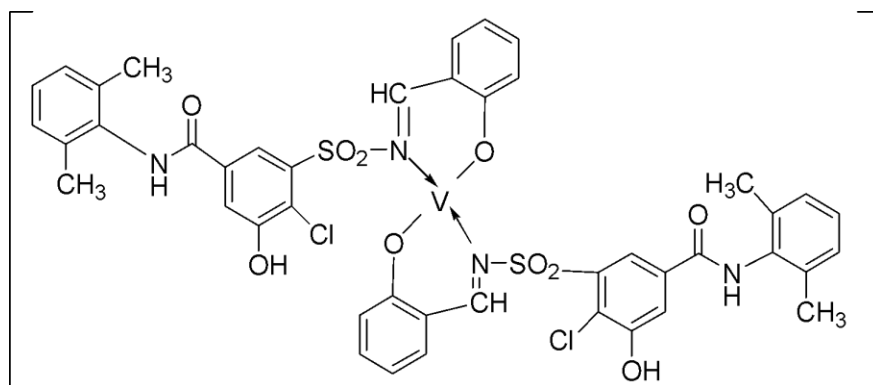


Fig.42: Schiff base metal complexes

A novel series of Schiff bases were synthesized and characterized by elemental analysis and spectral studies. The antifungal activity of compounds was screened against *C. albicans*. Experimental results indicated that the chloride substituted derivatives exhibited promising activity against tested fungi.<sup>64</sup>

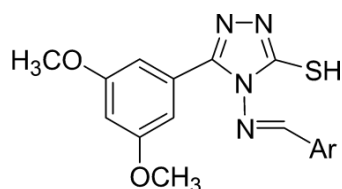


Fig. 43: Schiff base

A new series of Cr (+3) macrocyclic complexes and ligand have been synthesized as shown in fig 44. These complexes characterized by magnetic, analytical, XRD and spectral data. The newly prepared ligands and their metal complexes had been tested for their antifungal activities against *F. oxysporum* and *R. nigricans*. experimental data indicate that the metal chelates are more active than the ligands.<sup>65</sup>

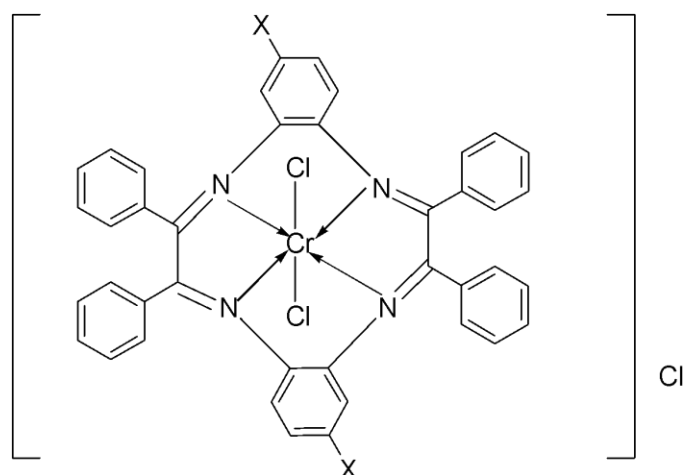


Fig.44: Cr (+3) macrocyclic complex.

The macrocyclic Schiff base ligand and its metal complexes have been prepared and characterized by elemental analysis, FT-IR, UV-VIS. , <sup>1</sup>H-NMR and mass spectroscopy. The prepared compounds are evaluated for their inhibition potential against fungal strains and the assay suggested that the metal complexes exhibited a significant antifungal activity against tested strains than the free ligand.<sup>66</sup>

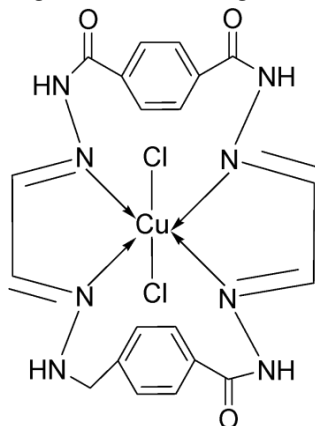


Fig.45: Cu (+2) macrocyclic complex.

The Schiff base ligands and its Ru (+3) complexes have been synthesized. The complexes were characterized by analytical and spectral studies and are formulated as [RuX(EPh<sub>3</sub>)(LL')<sub>2</sub>], where E=As or P, X= Cl or Br and LL' = monobasic bidentate Schiff base ligand. The Schiff bases and their complexes have been screened in vitro to evaluate their activity against *A. flavus* and *fusarium* species.<sup>67</sup>

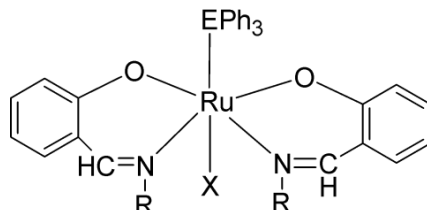


Fig.46: Structure of Ru (+3) complexes where, R= -CH<sub>3</sub>, -C<sub>6</sub>H<sub>11</sub>, - C<sub>5</sub>H<sub>4</sub>N

### 2.3. ANTICANCER:

**S. E. Abd El-Razek et al. (2020)** synthesized and characterized a dinuclear series of Cu(II), Ni(II), Co(II), Fe(III), Mn(II), Cr(III), Zn(II) and Bi(III) complexes with a new guanidine Schiff base ligand. The Cu(II) and Co(II) complexes demonstrated the most potent anti-cancer activities against HepG-2 and enhanced biological activities against G+ve and G-ve bacteria and fungi, with very few cytotoxic effects on normal cells when compared to the parent ligand and the standard drug. These effects were extremely rare in normal cells. Additionally, compared to the parent ligand and conventional medication, the newly synthesized complexes had improved anti-tumor and anti-microbial activities.<sup>68</sup>



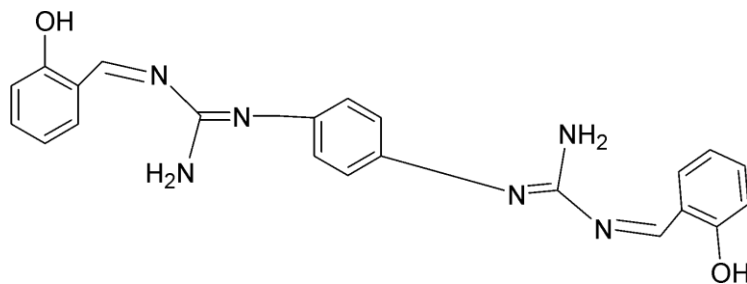


Fig. 47 : structure of Schiff base ligand

Sartaj Tabassum et al. (2013) synthesised Cu(II) based SOD mimics 1-4 [CuLH(OAc)(H<sub>2</sub>O)Y] (LH = 2-((E)-(1,3-dihydroxy-2-methylpropan-2-ylimino)methyl)-6-methoxyphenol, OAc = CH<sub>3</sub>COO, 1: Y = H<sub>2</sub>O; 2: Y = phen (1,10-phenanthroline), 3: Y = tpimH (2,4,5-triphenylimidazole); 4: Y = tfbimH (2-(trifluoromethyl)benzimidazole) and characterized. Using 16 human carcinoma cell lines of various histological origins, the in vitro anticancer efficacy of compounds 1-4 was examined. Complex 2 (fig 46) was more effective against 14 cell lines.<sup>69</sup>

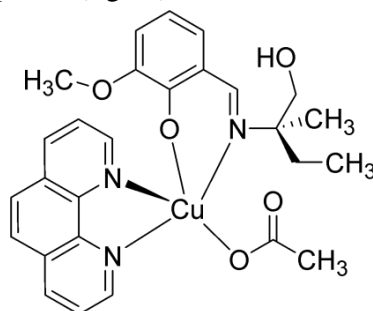


Fig. 48: Schiff base metal complex

M.Dekhodaei and M. Sahihi (2017) synthesized a new nano-scale Schiff base Ni (+2) complex and characterized by FT-IR, elemental analysis, single crystal XRD. The MIT assay result suggested that the anticancer activity of the compound is affected by its size.<sup>70</sup>

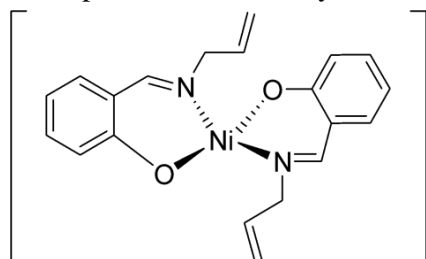


Fig. 49: Schiff base metal complex

Sutthida Wongsuwan et al.(2021) synthesised a series of Fe(II) complexes and Fe(III) complexes from Fe(II)/(III) chloride and N-(8-quinoly)-X-salicylalimine Schiff base ligands (Hqsal-X<sub>2</sub>/X: X = Br, Cl) and characterized them using FT-IR, 1H-NMR, mass spectrometry, TGA, and single crystal X-ray crystallographic techniques. While the free ligands and iron chloride salts did not exhibit any inhibitory effects at 100 μM, the complexes exhibited anticancer action toward the A549 cancer cells. Complex [Fe(qsal-Cl<sub>2</sub>)<sub>2</sub>]Cl 6 had the best anticancer activity in this series against A549 cells (IC<sub>50</sub> = 10 μM). This outperforms two well-known anticancer medications (Etoposide and Cisplatin).<sup>71</sup>

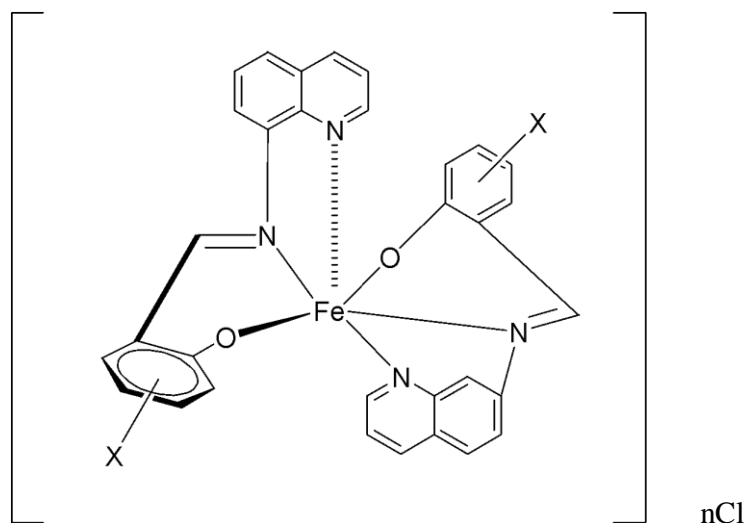


Fig: 50  $[\text{Fe}(\text{qsal-X}_2/\text{X})_2]_n\text{Cl}$

Schiff base and its metal complexes were synthesized and characterized. The synthesized complexes were used as precursor for their corresponding metal oxides nanoparticles under thermal decomposition and characterized by powder XRD and TEM. the cytotoxic activity of the synthesized complexes on human colon carcinoma cells and hepatic cellular carcinoma cells (HepG-2) exhibit potent cytotoxicity effect against growth of carcinoma cells as compared to the Vinblastine used as standard .<sup>72</sup>

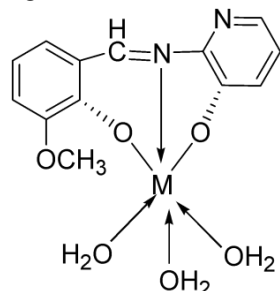


Fig. 51: Schiff base metal complexes

The synthesis of novel 1:1 Schiff base Cu complexes of quinoline-2-carboxaldehyde display close-dependent, antiproliferative and proapoptotic activity in PC-3 and LNCaP prostate cancer cell. Experimental data suggest that the most potent and inhibited proteasome activity in intact human prostate cancer PC-3 and LNCaP cells compared to Clioquinol .<sup>73</sup>

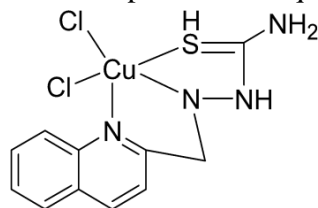


Fig. 52 : Schiff base metal complex

R.Gudipati et al. (2011) synthesised a series of 5- or 7- substituted 3-{4-(5-mercapto-1, 3,4-oxadiazol-2-yl)phenylimino}-indolin-2-one derivatives and characterized by spectral analysis.

Using the MTT assay, all the produced compounds were evaluated for their ability to inhibit the growth of HeLa cancer cell lines. Compounds 6b-anticancer d's activity was as potent as that of Cisplatin, a well-known anticancer drug. Compounds 6b-d containing halogen atoms (electron withdrawing groups) at C5 position displayed the most powerful action among the produced 2- indolinones. These findings suggest that C5 substituted compounds may provide valuable leads for the development of anticancer drugs in the future.<sup>74</sup>

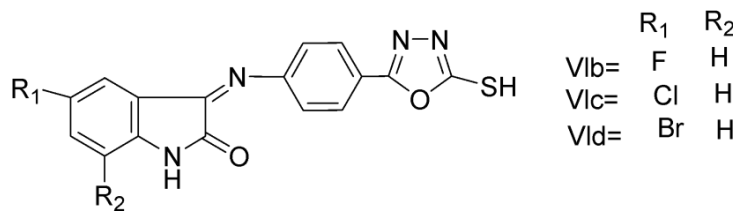


Fig 53: Schiff bases

Three novel transition metal coordination complexes,  $\text{Cu}(\text{C}_{18}\text{H}_{16}\text{N}_3\text{O}_2)_2 \cdot 2\text{CH}_3\text{OH}$  (1),  $\text{Zn}(\text{C}_{18}\text{H}_{16}\text{N}_3\text{O}_2)_2 \cdot 2\text{CH}_3\text{CH}_2\text{OH}$  (2) and  $\text{Cd}(\text{C}_{18}\text{H}_{16}\text{N}_3\text{O}_2)_2 \cdot 2\text{CH}_3\text{OH}$  (3) ( $\text{C}_{18}\text{H}_{16}\text{N}_3\text{O}_2$ : 2-acetylpyridine-L-tryptophan) were synthesized (*zhang et al. 2012*) and characterized by elemental analysis, IR, UV, <sup>1</sup>HNMR and X-ray diffraction single crystal analysis. The anticancer activities of these three complexes on MDA-MB-231 breast cancer cells were also investigated. The results show that all three complexes can inhibit the cellular proliferation. Furthermore, Cd ( $\text{C}_{18}\text{H}_{16}\text{N}_3\text{O}_2$ )<sub>2</sub> · 2CH<sub>3</sub>OH (3) has the highest anti-proliferative activity among the three complexes. It can inhibit proteasomal chymotrypsin- like activity and also can induce apoptosis on human breast cancer MDA-MB-231 cells.<sup>75</sup>

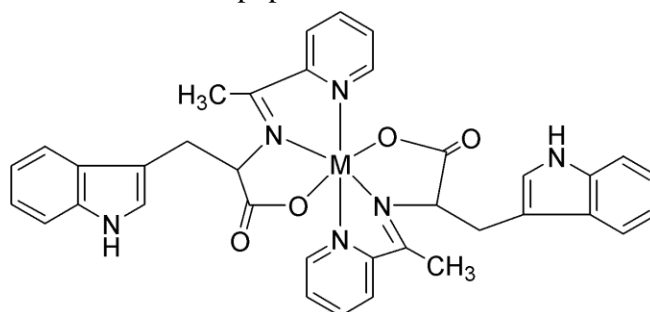


Fig. 54: Metal complexes where M= Cu, Zn, Cd.

A series of isonicotinoyl Schiff bases and their Cu (+2) complexes were synthesized and characterized (*pulipaka ramadevi et al.*). The compounds have been examined for their cytotoxicities on A549 human lung cell. Also the mode of cell death was examined employing various staining techniques and was found to be apoptotic.<sup>76</sup>

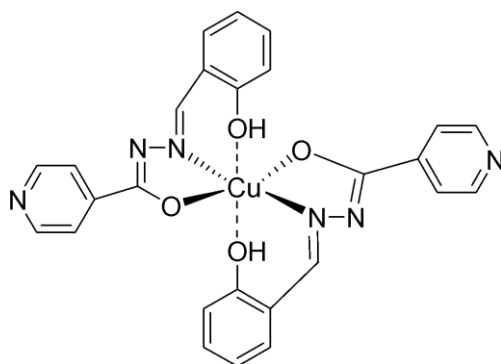


Fig. 55: Structure of metal complexes

## CONCLUSION

The biological applications of a few Schiff base and metal complexes have been examined in the current article. Despite the fact that Schiff base metal complexes have catalytic, biosensor, ion extraction, and anticorrosion properties, we have focused primarily on their biological uses. The majority of Schiff base and metal complexes have outstanding antibacterial, antifungal, and anticancer properties. According to studies, Schiff-base ligand metal complexes have superior antibacterial and anticancer properties than Schiff bases. To attain high biological activity, stronger Schiff base and metal complexes in the future may be created or altered.

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## *Chapter 10*

# **CONSTITUTIONAL PROVISIONS FOR ENVIRONMENTAL PROTECTION**

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### **INTRODUCTION**

After getting independence from the British rule in 1947, India was in full swing to get social, political, industrial and financial development. But at that time only two industries, cotton and jute were established, so government formed our industrial policies. As a result, many industries like coal, petroleum, aviation, steel, established and India tried to be economically strong. Initially, no attention was there towards the protection of environment which was going to be polluted due to this development although Indian penal code IPC had some sections related to such problems, but they were only prohibited provisions to fight against pollution. The Indian Constitution, was adopted in 1950, did not deal with that the subject of environment or prevention and control of pollution as such (until 1976 Amendment). Originally the constitution under article 372(1) has incorporated the earlier existing laws into the present legal system and provides that notwithstanding the repeal by the Constitution of enactment referred in article 379, but subjected to the other provisions of the Constitution, all laws in force immediately before the commencement of the constitution shall remain in force until altered, repealed or amended by a competent legislature or other competent authority. As a result, even after five decades of independence. The plethora of such laws is still in operation without any significant changes in them. (Environmental Laws and Constitutional Provisions In India, Advrdr).

The first world conference related to environmental protection was held in 1972 as United Nations conference in Stockholm. The Stockholm declaration, which contained 26 principles, placed environmental issues at the forefront of international concerns and marked the start of a dialogue between industrialised and developing countries on the link between economic growth, the pollution of air, water and oceans and the well-being of people around the world. This shows that it has been acknowledged on a global scale that one of a person's basic rights is to live in a clean environment and that he also has a responsibility to preserve the environment for the future generations.

The Stockholm convention was the first convention to discuss environmental issues on a global scale. The declaration proclaims truths relating to man and the environment such as man is the creator and moulder of his surroundings. In 1968-1969, the General Assembly, by Resolutions 2398 and 2581 decided to conduct the conference. The Stockholm Convention was held in Sweden from June 5-16, 1972. The object behind this convention was to “create a basis for comprehensive consideration within the United Nations of the problems of the human environment,” and to “focus the attention of Governments and public opinion in various countries on the importance of the problem.” This convention led UNEP to coordinate global action for the protection and preservation of the environment in December 1972. The Stockholm convention paved the way for other international conventions on the preservation of the environment such as the Convention on International Trade in Endangered Species of Wild Flora and Fauna, 1973. In the same line, the Parliament of India passed the Air (Prevention and Control of Pollution) Act, 1981, the Water (Prevention and Control of Pollution) Act, 1974, and the Forest Conservation Act, 1980 to give effect to the Stockholm convention.

The Water (Prevention and Control of Pollution) Act was amended in 1988. The Water (Prevention and Control of Pollution) Cess Act was enacted in 1977, to provide for the levy and collection of a cess on water consumed by persons operating and carrying on certain types of industrial activities. This cess is collected with a view to augment the resources of the Central Board and the State Boards for the prevention and control of water pollution constituted under the Water (Prevention and Control of Pollution) Act, 1974. The Act was last amended in 2003.

After that, The Air (Prevention and Control of Pollution) Act was amended in 1987 to provide for the prevention, control and abatement of air pollution in India. In 1986, the Environment (protection) Act, known as umbrella legislation designed to provide a framework for the coordination of central and state authority is established under the water (Prevention and control) Act 1974 and Air (Prevention and control) Act 1981. Various notifications under the EPA for the protection of ecologically sensitive areas or guidelines are issued time to time.

The main functions of CPCB, as spelt out in The Water (Prevention and Control of Pollution) Act, 1974, and The Air (Prevention and Control of Pollution) Act, 1981, are:

- (i) To promote cleanliness of streams and wells in different areas of the States through prevention, control and abatement of water pollution; and,
- (ii) To improve the quality of air and to prevent, control or abate air pollution in the country.

In addition to these main functions CPCB has been assigned following national level functions:

- Advise the Central Government on any matter concerning prevention and control of water and air pollution and improvement of the quality of air;
- Plan and cause to be executed a nation-wide programme for the prevention, control or abatement of water and air pollution;

- Co-ordinate the activities of the State Boards and resolve disputes among them;
- Provide technical assistance and guidance to the State Boards, carry out and sponsor investigations and research relating to problems of water and air pollution, and for their prevention, control or abatement;
- Plan and organise training of persons engaged in programmes for prevention, control or abatement of water and air pollution;
- Organise through mass media, a comprehensive mass awareness programme on prevention, control or abatement of water and air pollution;
- Collect, compile and publish technical and statistical data relating to water and air pollution and the measures devised for their effective prevention, control or abatement;
- Prepare manuals, codes and guidelines relating to treatment and disposal of sewage and trade effluents as well as for stack gas cleaning devices, stacks and ducts;
- Disseminate information in respect of matters relating to water and air pollution and their prevention and control;
- Lay down, modify or annul, in consultation with the State Governments concerned, the standards for stream or well, and lay down standards for the quality of air;
- Establish or recognise laboratories.
- Perform such other functions as and when prescribed by the Government of India.

Hence, the CPCB has been continuously playing a key role in abatement and control of pollution in the country by generating, compiling and collecting data, providing scientific information rendering technical inputs for formation of national policies and programmes, training and development of men power through activities for promoting awareness at different levels of government and public at large.

Initially, the obvious cause of environmental degradation were water and air. As the country start progressing, the causes of environmental degradation increases like due to urbanisation deforestation, over population, unsustainable agricultural and fishing practises, over consumption, mining operations, climate change mitigation which causes global warming, modern urbanisation, unplanned urbanisation, Industrialisation, increased amount of harmful gases, smoke by vehicles and factories in air, use of harmful chemicals in factories and excessive use of harmful chemicals in agriculture and overall noise pollution etc. Hence, the enactment of the Environment Protection Act (1986) which is umbrella legislation for enforcement of measures for protection of environment and act widened the scope of activities of the CPCB.

### **THE NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000-**

It is thought necessary to regulate and control noise producing and generating sources with the objective of maintaining the ambient noise levels in public spaces. The increasing

ambient noise levels in public places are caused by a variety of sources, including industrial activity, construction activity, generator sets, loud speakers, public address systems, music systems, vehicular horns, and other mechanical devices.

Whoever, in any place covered under the silence zone/area commits any of the noise pollution related offence, he shall be liable for penalty under the provisions of the Act.

### **NATIONAL ACTION PLAN ON CLIMATE CHANGE (NAPCC), 2008-**

This came into force with eight different national missions spread across different sectors to focus on sustainable development. To reduce and neutralise carbon emissions, numerous initiatives and programmes have been created under various missions. A national smart grid mission, a framework for energy-efficient economic development, an energy efficiency financing platform, a national afforestation programme, a national clean air programme, a climate change action programme, a smart cities mission, a green energy corridor project, an international solar alliance, energy efficiency standards for appliances, an energy conservation building code, fuel consumption standards, a national smart grid mission, and more are among them.(Carbon-neutral policies in India,Manisha singh, Asia business law journal )

### **THE INSECTICIDES ACT, 1968, ACT NO. 46 OF 1968**

An Act to regulate the import, manufacture, sale, transport, distribution and use of insecticides with a view to prevent risk to human beings or animals, and for matters connected therewith. This bill helps in controlling air and water pollution through insecticides. ([legislative.gov](http://legislative.gov))

### **PLASTIC WASTE (MANAGEMENT AND HANDLING) RULES, 2011**

The Ministry of Environment and Forests notified the Plastic Waste (Management and Handling) Rules, 2011, which replaced the earlier Recycled Plastics Manufacture and Usage Rules,1999 (amended in 2003). According to this rule The use of plastic materials in sachets for storing, packaging, or selling gutkha, tobacco, and pan masala is prohibited. Additionally, no food products may be packaged in recycled plastics or compostable plastics. Recycled carry bags must also meet certain BIS standards for colour and uniform thickness, which cannot be less than 40 microns.The municipal authority is in charge of developing, implementing, and coordinating the waste management system as well as carrying out the related tasks. This includes ensuring that plastic waste is collected, stored, transported, processed, and disposed of safely and without causing environmental harm. It also includes setting up collection centres for plastic waste involving manufacturers and directing it to recyclers. (Press Information Bureau, Government of India, Ministry of environment, Forest and climate change, 2011).

## **BIO-MEDICAL WASTE MANAGEMENT RULES, 1998**

Bio-medical Waste (Management & Handling) Rules, 1998 were notified by the Ministry of Environment & Forests (MoEF) under the Environment (Protection) Act, 1986. In exercise of the powers conferred by Section 6, 8 and 25 of the Environment (Protection) Act, 1986 (29 of 1986), and in supersession of the Bio-Medical Waste (Management and Handling) Rules, 1998 and further amendments made thereof, the Central Government vide G.S.R. 343(E) dated 28<sup>th</sup> March, 2016 published the Bio-medical Waste Management Rules, 2016. In addition to hospitals, nursing homes, clinics, dispensaries, veterinary institutions, animal houses, pathological laboratories, blood banks, ayush hospitals, clinical establishments, research or educational institutions, health camps, medical or surgical camps, vaccination camps, blood donation camps, first aid rooms of schools, and forensic laboratories, these rules apply to anyone who generates, collects, receives, stores, transports, treats, disposes of, or handles bio medical waste in any form.

## **THE FOREST (CONSERVATION) ACT 1980 ACT NO. 69 OF 1980-**

[27th December, 1980.] An Act to provide for the conservation of forests and for matters connected there with. The aim of the Forest conservation act, 1980 was to preserve the forest ecosystem of India by protecting the forest along with its flora and fauna, and other diverse ecological components and also decrease the loss of forest biodiversity, prevent forest land, being converted into agricultural, grazing or for any other commercial purpose and intentions. ([legislative.gov](http://legislative.gov))

## **CONCLUSION**

The Constitution of India has a number of acts, policies and rules to fight against pollution of every type whether it is air, water, noise or the land. But there is a lack of publicity of these rules or provisions provided by the constitution and lack of willingness in the individuals to follow these rules. In fact we don't find any obvious change by changing our lifestyles in accordance with these rules or provisions. The example is even odd use of vehicles in Delhi . As CPCB Delhi stated that while the odd-even system may result in some air pollution reduction, Delhi's air pollution levels cannot be significantly decreased by a single element or activity. Therefore, to significantly enhance air quality, a broad range of measures using an integrated approach are needed. There must be a list of activities to reduce the environmental pollution rather than not to do list. There must be an individual's report card what he has done to reduce the pollution and must get some appreciation for his contribution.

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# *Chapter 11*

## **ENVIRONMENTAL WELLNESS AND ROLE OF SCIENCE IN IT**

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### **INTRODUCTION-**

Environmental wellness refers to your sense of safety, comfort, and connection with your physical surroundings. It involves considering the interactions between your environment, your community, and yourself.

Since when we come in this world up to the last, we continuously keep on using all the divine resources which nature has for its own but we never think to compensate or feedback in anyway. It's not only our duty but essential to keep life smooth and long on this planet to return all we have received from it. As science has just concluded that the extreme weather conditions have taken place ages ago it's clear that it's obvious as that time human activity was quite little to disturb the environment but now the rapid changes are mainly due to human activity. Therefore it's our duty to take part in this campaign for the maintenance of environmental wellness.

Science is an art with logics which helps us to understand the world in a better way. Where Science has disclosed the various phenomenon of nature it has made the human life easier and Luxurious. All the "so called" development which have taken place world wide may come due to the science. The term "so called " is introduced as I think development has its meaning including the natural environment also so if we are developing only a part of our resources how it can be called development. We have lost a lot of our environment at the cost of development. But at the alarming time where science has destroyed a lot of our environment we should give science a responsibility to protect our environmental wellness.

### **TECHNOLOGIES -**

Recent technological breakthroughs have made it possible for communities to tackle longstanding environmental issues. Here are three of the most positive impacts of new technology on our planet's wellbeing.

### **CONSERVATION OF RESOURCES -**

Internet of Things (IoT) devices and smart household appliances can alert users about excessive energy waste and use AI to turn off the power when they are not in use.

For example, smart bulbs and thermostats can automatically detect activity in the room and turn off the light when there's nobody around, to help preserve energy.

A smart sprinkler system is able to adjust itself according to the weather and it regulates

water consumption levels, optimizing its impact on The water supply and the reducing water bills. Modern green buildings utilize natural light to reduce the coal consumption required to power them, which also results in lower lighting bills. In 2017, electric power accounted for 93% of coal consumption in the US. As a result of the implementation of smart technologies, the power sector in the US consumed 30% less coal in the first half of 2020 than in the same period in 2019.

In 2017, electric power accounted for 93% of coal consumption in the US. As a result of the implementation of smart technologies, the power sector in the US consumed 30% less coal in the first half of 2020 than in the same period in 2019. In addition, for every ton of paper produced, over 1.5 tons of carbon dioxide is released into the atmosphere.

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## **REAL LIFE EXAMPLES -**

Let's look at a few other real-life examples of technology's beneficial impact on the environment.

In 2012, volunteers in New York City roamed the city taking measurements at the street level. They followed a usual route a typical NYC adult takes every day. The results showed that

1% of the city's buildings were emitting more pollutants than all the city's cars combined! They launched a program called Clean Heat in cooperation with the city's ex-Mayor Bloomberg. Backed by private funding, they helped 6,000 buildings upgrade to cleaner fuel. In 2016, the World Wildlife Fund (WWF) teamed up with Apple to start the Apps for Earth campaign that raised \$8 million and educated millions of people about nature conservation issues.

A few years later, a new campaign called WWF Free Rivers used Apple's augmented reality technology to educate people on the importance of free-flowing rivers. Intel and WWF also teamed up in China and used the power of AI to protect wild tigers' habitats and numerous other species.

In 2017, the entire United Kingdom ran without coal power for three days between April 21st and 24th for the first time since the 19th century, when coal was first used as a source of energy. The country's electricity was supplied by gas, windfarms, biomass, solar and nuclear power – all cleaner sources of energy than coal.

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## **CONCLUSION -**

Thus we see that where science in corporation with development has damaged our environment we can guide it in a controlled and sustainable manner for environmental wellness. Although we can never compensate 100 percent but still we should give our best for the sake of generations and the only valuable thing that is life.

## Chapter-12

### RELEVANCE OF NANO BIOSENSORS IN ECO HAZARDS

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#### ABSTRACT –

Tiny organism viruses and their related diseases can be harmful for humanity. Sometimes this hazard situation is putting the human life on the brink of collapse. So it is the most significant step taken to prevent this hazard by the different diagnostic techniques. There are many traditional methods used for detecting viruses, such as molecular approaches, serological methods, direct virus culture methods and so on. But these methods are not sufficient because some stages are not devoid of drawbacks. Presently new techniques are introduced or developed in the medical area which eradicates the demerits of previous procedures. Biosensors have come up with a lot of benefits in terms of detecting viruses and their diseases. Various types of viruses appear, so various types of biosensors are designed such as affinity based biosensors, graphene affinity based biosensors, nanowires based biosensors, optical nano biosensors, nano island affinity based biosensors, fiber optic nano biosensors, surface plasmon resonance (SPR) based optical nano biosensors. Electro chemical nano biosensors are sensitive to detect viruses quickly. Biosensors are transducing the biochemical events into electrical signals.

*Keywords; Nano materials, Biosensors.*

#### 1. INTRODUCTION -

Sensing the biological responses has assumed great significance in the current scenario of ever dynamic environmental developments. The analysis of behavior of the nano materials has great significance in areas like pharmaceutical diagnosis, screening food quality, and environmental applications. For observation of minutest details of the biological interactions the efficient biosensors are developed, which deserves maximum ever possible sensitivities urgent attention even at a very small scale [1]. Nano materials, cause of small dimension as they have high surface area to volume ratios which allow the surface to be used in a better and far more diversely functional manner. The functions of the bio sensing is the transduction mechanisms, which are responsible for converting the responses of bioanalyte interactions and reproducible the conversion of specific biochemical reaction energy into an electrical form. Nano materials have their wonderful electromechanical properties for the biosensor technology. The revolution

of nanotechnology provides wonderful nano structural. Which provides an opportunity for manipulation of atoms and molecules and monitored the biological phenomenon at the physiological level with far greater precision, nano as often implies the use or manipulation at a scale equivalent to one-billionth of a meter.

### **TYPE OF NANOBIOSENSORS -**

The classification of nano biosensors are very diverse area. These are based on the nature of nano materials incorporated in the bio sensing operation, such as nano particles based nano biosensor, Nanotube Based Sensors, Nanowire Based Sensors. Nano particle based biosensors are made by nano materials and increase the signals strength, this is also define in three categories acoustic wave biosensors, magnetic biosensors, electrochemical biosensors. Acoustic wave biosensors have been developed to amplify the sensing responses so as to improve the overall preciseness of the limits of bio detection. The large mass of bound sol particles of the antibody change in the vibrational frequency of the quartz based sensing platform, this change behaves as the detection. Generally the preferred diameter of the sol based antibody particles is between 5 and 100 nm. The gold, platinum, cadmium sulphide, titanium dioxide particles are preferred [2,3]., Magnetic biosensors utilize the specially designed magnetic nanoparticles and these are mostly based on ferrite materials. These devices are screened the specific antigens from the mixtures by using antibodies bound to magnetic nanoparticles [4]. Electro chemical biosensors, these sensors basically work to facilitate or analyze the biochemical reactions with the help of improved electrical means. Since their discovery in 1990's Carbon nanotubes are one of the most popular nano materials known right now in the world for optoelectronic applications. They have attracted extraordinary properties such as electronic conductivity, flexible physical geometric features, and mechanical properties having high mechanical strength and folding abilities. Because of these features in both single wall nanotubes and multi wall nanotubes have been used in designing biosensors for better and better performances [5, 6]. Nanowire based biosensors. In one such study, Cui and Lieber group have reported the performance of biosensors based on silicon nanowires doped with boron and used them for the detection of biological and chemical species [7].

### **APPLICATIONS AND CONCLUSION -**

The biosensors are applicable in screening of viruses and bacteria as biomedical and diagnostic applications. The existence of human life is impossible without environment sobiosensors are useful in environmental applications. The biosensors are also part of miscellaneous applications such as in the industrial operation. Nanotechnology has really proved to be a very significant blessing in the development of biosensors. It has revolutionized the case of biological detection. The transduction mechanisms have been significantly improved with the use of nanomaterials and nanostructures like those of quantum dots, nanoparticles for enzyme immobilization, and hybrid nanostructures with multiple functionalities.

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## *Chapter 13*

### **CONSERVATION OF BIODIVERSITY: PRESERVING ECOSYSTEMS AND PROTECTING ENDANGERED SPECIES**

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#### **INTRODUCTION -**

Biodiversity can be defined as the variety of plants, animals, and microorganisms that exist, the genes they contain, and the ecosystems they live in. It provides a variety of goods and services and supports our economy and lifestyles. Man has a moral duty to conserve it to ensure long-term sustainability for human survival and future generations. Trees are an example of critical component of biodiversity. The diversity of life that a tree can support is incredible. For example, in the tropical rainforests, a single tree can house up to 2000 different species of insects, birds, amphibians, reptiles, mammals, fungi, mosses, and epiphytic plants. Unfortunately, natural habitats everywhere are declining. Therefore, the establishment of protected area networks is essential for biodiversity conservation and thus helps to reduce its loss. As habitats are lost, we are also losing various types of precious flora and fauna. No one would have thought, even a few years ago, that some species from the families of Dipterocarpaceae, Grammitidaceae, and Begoniaceae could be extinct, but now they are. Protected areas can be used as complementary measures to achieve sustainable use of biodiversity and protect many threatened and endemic species from becoming vanished.

#### **SIGNIFICANCE OF BIODIVERSITY:**

- Biodiversity encompasses the variety of life forms, including genes, species, and ecosystems.
- It provides numerous ecological services such as nutrient cycling, pollination, and climate regulation.
- Biodiversity also has intrinsic value, cultural significance, and contributes to the overall resilience of ecosystems.

## **ECOSYSTEMS AT RISK -**

- Habitat loss and fragmentation due to human activities like deforestation, urbanization, and infrastructure development.
- Pollution from industrial waste, agricultural runoff, and improper waste disposal.
- Climate change and its impacts on temperature, precipitation patterns, and sea level rise.
- Invasive species that outcompete native species and disrupt ecosystems.
- Overexploitation of natural resources, including overfishing, poaching, and illegal wildlife trade.

## **WHAT IS THE IMPORTANCE OF CONSERVATION AND BIODIVERSITY PRESERVATION?**

Conservation refers to the sustainable management and protection of natural resources, including ecosystems and species.

It is vital for maintaining ecological balance, promoting biodiversity, and ensuring the well-being of both humans and wildlife.

Conservation and biodiversity preservation are of utmost importance for several compelling reasons:

1. Maintain ecosystem stability and functionality.
2. Provide valuable ecosystem services like clean air and water.
3. Enhance resilience and adaptation to environmental changes.
4. Support economic prosperity and livelihoods.
5. Uphold ethical responsibilities and respect intrinsic value.
6. Safeguard cultural diversity and traditional knowledge.
7. Contribute to climate change mitigation and carbon storage.

## **CONSERVATION APPROACHES AND STRATEGIES**

Conservation approaches and strategies encompass a wide range of practices and initiatives aimed at protecting and preserving the natural environment and its biodiversity. Here are some key conservation approaches and strategies:

1. **PROTECTED AREAS:** Establishing and managing protected areas such as national parks, wildlife sanctuaries, and nature reserves to safeguard important ecosystems, habitats, and species.
2. **HABITAT RESTORATION:** Rehabilitating and restoring degraded habitats to enhance biodiversity and promote the recovery of ecosystems. This can involve activities such as reforestation, wetland restoration, and coral reef rehabilitation.
3. **SPECIES CONSERVATION:** Implementing measures to protect endangered species, including conservation breeding programs, habitat conservation, and anti-poaching efforts. This may involve captive breeding, reintroduction programs, and monitoring of populations.



4. **SUSTAINABLE RESOURCE MANAGEMENT:** Promoting sustainable practices for managing natural resources, such as forests, fisheries, and water sources. This includes responsible harvesting, monitoring of resource use, and implementing regulations and policies.
5. **COMMUNITY-BASED CONSERVATION:** Involving local communities in conservation efforts by recognizing their traditional knowledge, empowering them to manage natural resources sustainably, and providing incentives for conservation.
6. **ECOSYSTEM-BASED APPROACHES:** Focusing on the holistic management of ecosystems, considering the interactions between species, habitats, and ecological processes. This approach emphasizes maintaining the overall health and functioning of ecosystems.
7. **CONSERVATION EDUCATION AND AWARENESS:** Promoting public awareness and understanding of conservation issues through education, outreach programs, and campaigns. This helps foster a sense of stewardship and encourages individuals to act.
8. **POLICY AND ADVOCACY:** Influencing policies and advocating for stronger environmental regulations and conservation measures at local, national, and international levels. This includes engaging with governments, organizations, and stakeholders to drive change.
9. **SCIENCE AND RESEARCH:** Conducting scientific research to improve understanding of ecosystems, species, and conservation challenges. This knowledge informs conservation strategies and helps identify effective interventions.
10. **INTERNATIONAL COOPERATION:** Collaborating across borders to address global conservation challenges, such as climate change, illegal wildlife trade, and habitat loss. This involves sharing expertise, resources, and best practices among countries.
11. **SUSTAINABLE DEVELOPMENT:** Integrating conservation objectives into development planning to ensure that economic growth and human well-being are achieved in harmony with the environment.
12. **TECHNOLOGY AND INNOVATION:** Utilizing advancements in technology, such as remote sensing, genetic analysis, and data-driven approaches, to enhance conservation monitoring, management, and decision-making.

## **HABITAT RESTORATION -**

Habitat restoration is a vital process that involves the deliberate efforts to revive and rehabilitate degraded or destroyed ecosystems. It encompasses various activities, including reforestation, wetland restoration, and the reintroduction of native species. By repairing and enhancing natural habitats, habitat restoration aims to reverse the negative impacts of human activities, such as habitat fragmentation, pollution, and invasive species. It plays a crucial role in preserving biodiversity, improving ecosystem functions, and promoting environmental wellness. Successful habitat restoration projects not only provide habitats for wildlife but also contribute to

climate change mitigation, water quality improvement, and the overall sustainability of ecosystems for present and future generations.

## **SUSTAINABLE LAND AND RESOURCE MANAGEMENT: BALANCING HUMAN NEEDS AND CONSERVATION**

The challenge of balancing human needs and conservation objectives has become increasingly critical as human populations expand and compete for limited resources. Conservation efforts are often met with resistance or perceived as hindrances to economic development, leading to conflicts and unsustainable practices. However, it is crucial to recognize that human well-being is intricately connected to the health of natural ecosystems. Achieving a balance between human needs and conservation is essential for long-term sustainability and the preservation of biodiversity.

### **STRATEGIES FOR SUSTAINABLE COEXISTENCE:**

1. Community-Based Conservation:
2. Ecosystem-Based Management:
3. Integrated Land-Use Planning
4. Sustainable Resource Use

## **PRESERVING GENETIC DIVERSITY AND POPULATION VIABILITY**

Maintaining high genetic diversity allows species to adapt to future environmental changes and avoid inbreeding.

Inbreeding, which happens when there are small, isolated populations, can reduce a species' ability to survive and reproduce. Populations with low genetic diversity have a smaller buffer when it comes to evolving to their ever-changing environment.

Genetic diversity provides the basis for adaptation and resilience, enabling species to withstand environmental challenges. Population viability ensures that species can maintain sustainable populations, reducing the risk of extinction. Conservation efforts should focus on preserving genetic variability through strategies such as habitat conservation, captive breeding programs, and genetic management. By safeguarding genetic diversity and promoting population viability, we can enhance the resilience and survival prospects of species, contributing to the overall biodiversity and ecological balance of our planet.

## **ENDANGERED SPECIES CONSERVATION**

Roughly 99 percent of threatened and endangered species are at risk because of human activities. The principal threats are habitat loss and degradation, the spread of invasive species, the growing influence of global warming, chemical pollution, unsustainable hunting, and disease

### **WHY IS IT SO IMPORTANT FOR US TO PROTECT SPECIES?**

#### **1. ECOLOGICAL IMPORTANCE**

Healthy ecosystems depend on plant and animal species as their foundations. When a species becomes endangered, it is a sign that the ecosystem is slowly falling apart. Each species

that is lost triggers the loss of other species within its ecosystem. Humans depend on healthy ecosystems to purify our environment. Without healthy forests, grasslands, rivers, oceans, and other ecosystems, we will not have clean air, water, or land. If we allow our environment to become contaminated, we risk our own health.

## **2. MEDICAL**

Over 50% of the 150 most prescribed medicines were originally derived from a plant or other natural product. Unfortunately, only about 5% of known plant species have been tested for medicinal uses and there are thousands of plant species that have yet to be identified. Tens of thousands of Americans die every year from illnesses for which there is no known cure. The cures for these diseases may eventually come from plants, therefore, we must protect all species before they are lost forever from nature's medicine cabinet.

## **3. AESTHETIC/RECREATIONAL**

The American tourism industry is dependent on plant and animal species and their ecosystems for their multi-billion-dollar, job-intensive industry. Every year, millions of people visit natural areas in the US and participate in wildlife related activities. From woodland hikes to beach going, outdoor activities are the second most popular travel activity (Travel Industry Association of America). The U.S. Park Service logs over 200 million visitors to our National Parks every year. The local economies of these areas benefit from activities associated with these visits. The preservation of our nation's biological diversity is an immensely important facet to the survival of the travel industry.

## **4. AGRICULTURAL**

Agriculture also plays a key role in the protection of species; farmers are often seen as the original conservationists. Many farmers set aside portions of their land as wildlife habitat and work in partnership with groups such as Trout Unlimited to restore river and stream habitats for endangered and threatened fish and reptiles. In addition, wild relatives of common crops contain important genetic material needed to maintain these crops. These relatives can be used to ensure crops are disease-resistant while providing information for developing new crops that can grow in less than adequate lands.

## **THREATS TO ENDANGERED SPECIES: HABITAT LOSS, CLIMATE CHANGE, AND POACHING**

**HABITAT LOSS** is extensive in the region, over 75% of the original Himalayan habitat has been destroyed or degraded. Fuelwood and fodder collection has damaged forests and grasslands. Extensive livestock grazing has displaced and outcompeted wild species, and rapid development is removing species habitat and fragmenting populations.

**POACHING**, and unsustainable hunting for the commercial wildlife trade, are endangering the flagship species of the Eastern Himalayas. The demand for tiger and rhino parts, for example - highly prized in East Asian medicine - places these species under extreme threat. **WILDLIFE KILLING** also takes place because of conflict with humans. Retaliation against tigers and snow leopards for killing livestock, and against elephants and rhinos for eating crops,

is common and continues to intensify as humans and wildlife compete for land and other resources.

**CLIMATE CHANGE** further exacerbates the impacts from all of these threats, by altering the natural environmental flow of resources in the region; inflicting extra pressure on ecosystems, livelihoods, and biodiversity.

## **WILDLIFE TRAFFICKING: IMPACTS AND COUNTERMEASURES -**

Wildlife trafficking has been using aviation global network to perform its illegal activities, causing serious environmental damage and similar effects as other international crimes, including promoting instability, financing organized crime and adversely affecting communities that live from wildlife tourism. In spite of the international (and national) legal frameworks, including the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), illegal wildlife trade is the fourth most lucrative global crime valued up to US\$20 billion a year.

The impact of illegal wildlife trade (IWT) on species has reached unprecedented levels in recent years.

This trade, estimated to be worth \$7 – 23 billion per year, is the world's fourth most lucrative trafficking industry after drugs, humans, and weapons, posing a serious threat to the survival of some of our most beloved species as well as the ecosystems on which they rely. Let us discuss the consequences individually.

Many of the world's most valuable species are on the verge of extinction – And the illegal wildlife trade has its share in this. Illegal wildlife trade threatens species populations and can result in the extinction of species, both, locally and globally.

When poachers and wildlife traders capture and trade endangered species to meet black-market demand, they are threatening the life and survival of these species. This risk of extinction is intensified by the poachers' approach, who oftentimes aim at capturing the fittest and most healthy individuals of a population. This may lead to serious consequences for the reproduction and continued existence of a particular species.

## **WILDLIFE TRAFFICKING COUNTERMEASURES -**

**STRENGTHENING LEGAL FRAMEWORKS:** Enacting and enforcing robust legislation and regulations that specifically target wildlife trafficking. This includes establishing severe penalties for offenders and implementing strict controls on the sale and transportation of wildlife products.

**INTERNATIONAL COLLABORATION:** Promoting cooperation among countries to combat wildlife trafficking through information sharing, intelligence-led operations, and joint law enforcement efforts. This includes supporting international agreements, such as the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

**LAW ENFORCEMENT AND INTERAGENCY COOPERATION:** Enhancing the capacity and coordination of law enforcement agencies, customs, and border control units to detect,

investigate, and prosecute wildlife traffickers. This involves training personnel, establishing specialized wildlife crime units, and fostering collaboration between different agencies.

**DEMAND REDUCTION CAMPAIGNS:** Raising awareness among consumers about the negative impacts of wildlife trafficking and encouraging behavior change. This includes education campaigns, targeted messaging, and initiatives to promote sustainable alternatives to wildlife products.

**COMMUNITY ENGAGEMENT:** Involving local communities in conservation efforts by providing alternative livelihoods, supporting sustainable resource management practices, and empowering communities to protect wildlife and report illegal activities.

**TECHNOLOGY-BASED SOLUTIONS:** Utilizing innovative technologies such as remote sensing, DNA analysis, and digital platforms to detect and track illegal wildlife trade. This includes the use of drones, satellite imagery, and online monitoring to identify trafficking hotspots and disrupt supply chains.

**COLLABORATION WITH NGOS AND CIVIL SOCIETY:** Partnering with non-governmental organizations and civil society groups to strengthen anti-trafficking efforts, promote public awareness, and support conservation projects.

**CAPACITY BUILDING AND TRAINING:** Providing training and capacity-building programs to law enforcement agencies, judiciary personnel, and wildlife authorities to enhance their skills in combating wildlife trafficking and ensuring effective prosecution.

**INTERNATIONAL AID AND SUPPORT:** Providing financial and technical assistance to countries affected by wildlife trafficking, particularly in developing regions, to enhance their capacity for enforcement, monitoring, and conservation.

**STRENGTHENING COOPERATION WITH LOCAL AND INDIGENOUS COMMUNITIES:** Recognizing the role of local and indigenous communities as stewards of their natural resources and involving them in decision-making processes and conservation efforts.

## **ENGAGING LOCAL COMMUNITIES IN CONSERVATION EFFORTS -**

**COMMUNITY-BASED CONSERVATION INITIATIVES:** Collaborating with local communities to develop and implement conservation programs that align with their needs and aspirations. This involves recognizing their traditional knowledge, values, and cultural practices related to the environment and integrating them into conservation strategies.

**PARTICIPATORY DECISION-MAKING:** Involving local communities in decision-making processes, such as the establishment of protected areas, sustainable resource management, and land-use planning. This ensures that their perspectives and interests are considered, fostering a sense of ownership and responsibility for conservation outcomes.

**CAPACITY BUILDING AND EDUCATION:** Providing training and capacity-building programs to local community members to enhance their understanding of conservation principles, sustainable practices, and the importance of biodiversity. This empowers them to actively participate in conservation efforts and become ambassadors for environmental stewardship.

**ALTERNATIVE LIVELIHOODS:** Supporting the development of alternative income-generating activities that are environmentally sustainable and compatible with conservation goals. This helps reduce pressure on natural resources and provides economic incentives for local communities to engage in conservation practices.

**BENEFIT-SHARING AND INCENTIVES:** Establishing mechanisms to ensure that local communities directly benefit from conservation efforts. This can include revenue-sharing schemes, ecotourism initiatives, and access to sustainable natural resource utilization, creating economic incentives for communities to protect and preserve their local ecosystems.

**COLLABORATIVE RESEARCH AND MONITORING:** Engaging local communities in research and monitoring activities to gather valuable information about local biodiversity, ecological processes, and threats. This fosters a sense of ownership and empowers communities to actively contribute to scientific knowledge and conservation planning.

**ENVIRONMENTAL EDUCATION AND AWARENESS:** Promoting environmental education programs within local communities to raise awareness about the importance of conservation, the value of biodiversity, and the impacts of unsustainable practices. This can be done through schools, community centres, and public outreach initiatives.

**Indigenous and Traditional Knowledge Integration:** Recognizing and respecting the traditional ecological knowledge held by indigenous communities and integrating it into conservation strategies. This ensures a holistic approach that combines scientific knowledge with traditional practices for effective conservation outcomes.

**NETWORKING AND PARTNERSHIPS:** Facilitating networking and collaboration between local communities, non-governmental organizations, government agencies, and other stakeholders. This allows for the sharing of experiences, knowledge, and resources, fostering a sense of collective responsibility for conservation.

**LONG-TERM ENGAGEMENT AND EMPOWERMENT:** Ensuring sustained engagement with local communities by fostering long-term relationships, providing ongoing support, and empowering them to take an active role in conservation decision-making and implementation.

## **HUMAN WILDLIFE CONFLICTS -**

**HUMAN-WILDLIFE CONFLICT IS WHEN ENCOUNTERS BETWEEN HUMANS AND WILDLIFE LEAD TO NEGATIVE RESULTS, SUCH AS LOSS OF PROPERTY, LIVELIHOODS, AND EVEN LIFE.** Defensive and retaliatory killing may eventually drive these species to extinction. These encounters not only result in suffering for both people and wildlife immediately impacted by the conflict; they can also have a global reach, with groups such as sustainable development agencies and businesses feeling its residual effects. The scope

of the issue is significant and truly global, but we are nowhere near being able to address it at the scale needed

Human-wildlife conflicts refer to situations where there is a direct or indirect negative interaction between humans and wildlife, often resulting in economic, social, or environmental impacts. These conflicts arise when the needs and activities of humans overlap with the natural habitats and behaviours of wildlife. Common examples include crop raiding by elephants, livestock predation by carnivores, and conflicts over resources such as water or territory.

Human-wildlife conflicts can have significant consequences. They can lead to economic losses for farmers, disrupt local livelihoods, pose threats to human safety, and result in the retaliatory killing of wildlife. Furthermore, these conflicts can contribute to the decline of endangered species and damage ecosystems if not addressed effectively.

#### **HUMAN-WILDLIFE CONFLICT CAN BE REDUCED BY FOLLOWING CERTAIN MEASURES:**

- Creating more Protected Areas and buffer zones
- Steps must be taken to enhance the safety of people and wildlife and to create mutual benefits of coexistence
- Local communities can also participate in devising measures to reduce this conflict
- The concerned authorities must devise a strategy and action plan to reduce human-wildlife conflict at a national level
- Before camping, hiking, or venturing into natural areas, learn about the animals that you might encounter

#### **SUSTAINABLE SOLUTIONS FOR WILDLIFE AND HUMAN CONFLICT**

- Habitat Conservation and Restoration
- Land-use Planning and Zoning
- Community Engagement and Participations.
- Education and Awareness
- Livelihood Development and Alternative Income Sources
- Technical Solutions and Deterrents
- Compensation and Insurance Schemes
- Research and Monitoring

#### **THE ROLE OF SUSTAINABLE DEVELOPMENT IN BIODIVERSITY CONSERVATION**

Sustainable development plays a crucial role in biodiversity conservation by promoting the harmonious coexistence of human activities and the natural environment. Here are some key aspects of sustainable development and how they contribute to biodiversity conservation:

**INTEGRATION OF CONSERVATION AND DEVELOPMENT GOALS:** Sustainable development seeks to integrate social, economic, and environmental considerations. By recognizing the interdependence between human well-being and healthy ecosystems, it emphasizes the importance of preserving biodiversity as a foundation for sustainable development.

**CONSERVATION-ORIENTED LAND-USE PLANNING:** Sustainable development advocates for responsible land-use planning that considers biodiversity conservation. This includes the establishment of protected areas, wildlife corridors, and ecological networks to maintain habitat connectivity and protect critical ecosystems.

**SUSTAINABLE RESOURCE MANAGEMENT:** Sustainable development promotes the responsible management of natural resources, such as forests, fisheries, and water bodies. Applying sustainable practices, such as sustainable logging, responsible fishing techniques, and water conservation measures, helps minimize the negative impacts on biodiversity and ensures long-term resource availability.

**COMMUNITY ENGAGEMENT AND EMPOWERMENT:** Sustainable development recognizes the importance of involving local communities in conservation efforts. Engaging communities in decision-making processes, providing alternative livelihood options, and respecting traditional knowledge can foster a sense of ownership and encourage sustainable practices that benefit both communities and biodiversity.

**CONSERVATION FINANCE AND INCENTIVES:** Sustainable development emphasizes the need for financial mechanisms and incentives to support biodiversity conservation. This includes mechanisms like payment for ecosystem services, eco-tourism revenue sharing, and green financing, which provide economic incentives for conserving biodiversity.

**EDUCATION AND AWARENESS:** Sustainable development recognizes the importance of education and raising awareness about biodiversity conservation. By promoting environmental education, public outreach campaigns, and capacity building, sustainable development fosters a greater understanding of biodiversity values and the need for its protection.

**INTERNATIONAL COOPERATION:** Sustainable development calls for global cooperation and partnerships to address biodiversity conservation. This includes sharing knowledge, best practices, and resources among nations, supporting international agreements like the Convention on Biological Diversity (CBD), and implementing joint conservation initiatives.

**MONITORING AND ASSESSMENT:** Sustainable development emphasizes the importance of monitoring and assessing biodiversity and ecosystem health. Regular monitoring helps track changes in biodiversity, assess the effectiveness of conservation efforts, and identify potential threats or challenges that require mitigation.

By integrating sustainable development principles into biodiversity conservation efforts, we can ensure the long-term protection and sustainable use of biodiversity while promoting human well-being and equitable development. It enables us to address the current biodiversity crisis and work towards a future where ecosystems and human societies thrive in harmony.



## CONCLUSION

Conservation and biodiversity preservation are urgent and critical endeavors in the face of increasing threats to ecosystems and endangered species. It is our responsibility as individuals and as a collective to take action and ensure the protection of our planet's natural heritage.

The urgency of conservation arises from the understanding that ecosystems are under immense pressure from various human activities. Habitat loss, pollution, climate change, and overexploitation of resources have led to a significant decline in biodiversity and the degradation of ecosystems worldwide. The consequences of these actions are far-reaching, affecting not only wildlife but also human well-being and the overall health of our planet.

Preserving ecosystems and protecting endangered species requires a multi-faceted approach. It involves implementing sustainable land and resource management practices, promoting habitat restoration, and mitigating the impacts of climate change. Conservation efforts also rely on the enforcement of laws and regulations against illegal wildlife trade and the establishment of protected areas.

Furthermore, conservation is not solely the responsibility of governments and organizations. Everyone has a role to play in making environmentally conscious choices, such as reducing consumption, supporting sustainable practices, and advocating for change. It is through collective action and awareness that we can create a significant impact in safeguarding ecosystems and species.

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## Chapter 14

# **CALCULATE, NEUTRALIZE AND REDUCE CARBON FOOTPRINT ENVIRONMENTAL JUSTICE FOR SUSTAINABLE DEVELOPMENT**

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### **ABSTRACT**

Carbon footprint represents the total volume of greenhouse gases (GG) resulting from everyday economic and human activity. Knowing the carbon footprint of an activity, which is measured in tons of CO<sub>2</sub> emissions, is important when it comes to launching initiatives to reduce it to the lowest possible level. When anyone travels by car, charges his/her mobile phone, switches on the TV or run the washing machine, and many other thousands of routine activities, he/she leaves a trail of gases that build up in the atmosphere and contribute to global warming and speeds up climate change. United Nations warns in its Sustainable Development Goals (SDG), and if it is not neutralised in time by decarbonising the economy and through other measures such as environmental taxes, a far more inhospitable world is just around the corner. It is possible only through public-private partnership. Equal importance should be given to appropriate technology innovation and Research & Development. Awareness programmes should be done to facilitate everybody's access to resources and contemporary knowledge and skills. To achieve this goal, many companies are now looking seriously at the environmental impact of their activities, and how they can minimize the carbon they produce. Projects should be undertaken like growing microorganisms which are the most productive biological systems for generating biomass and capturing carbon. Every individual should measure and reduce his/her home and cloud carbon emissions. If number is higher than one should take small measures in order to lower carbon footprint, such as recycling, utilizing these daily tips, or purchasing carbon offsets.

*Key Words: Carbon Footprint, Sustainable development, Carbon emission, Climate change, Global warming, Green house gases, decarbonizing*

A carbon footprint is the total amount of greenhouse gases (including carbon dioxide and methane) that are generated by our actions. It is defined as the amount of greenhouse gases, primarily carbon dioxide (CO<sub>2</sub>), released into the atmosphere by a particular human activity. To

quantify this term Carbon Footprints came into play. It includes direct emissions, such as those that result from fossil-fuel combustion in manufacturing, heating, and transportation, as well as emissions required to produce the electricity associated with goods and services consumed. “In addition, the carbon footprint concept also often includes the emissions of other greenhouse gases, such as methane, nitrous oxide, or chlorofluorocarbons (CFCs).” Britannica

### **CARBON FOOTPRINT IMPACT ON THE ENVIRONMENT-**

In general, carbon dioxide is released on Earth by three means – decomposition, respiratory, and ocean release. In simpler words, global economic and industrial activities play a central role in increasing carbon dioxide in the atmosphere, and carbon footprint is the measure of their impact on the environment.

The average carbon footprint for a person in the United States is 16 tons, one of the highest rates in the world. Globally, the average carbon footprint is closer to 4 tons. To have the best chance of avoiding a 2- rise in global temperatures, the average global carbon footprint per year needs to drop to under 2 tons by 2050. Our carbon footprint has a negative impact on the environment in multiple ways: It is the main cause of human-induced climate change, it contributes to urban air pollution, it leads to toxic acid rain, it adds to coastal and ocean acidification, and it worsens the melting of glaciers and polar ice.

### **GLOBAL CARBON DIOXIDE EMISSIONS 2010-2021 -**

China and the United States are the largest polluters in the world by far, having released 11.5 and 5.0 billion metric tons of carbon dioxide emissions in 2021, respectively. Despite being the second-largest polluter, U.S. emissions have declined by 12 percent since 2010. In comparison, China’s carbon dioxide emissions have increased by over 33 percent. Although China is currently the world's largest carbon polluter, it has released roughly half the cumulative carbon dioxide emissions the U.S. has since 1750, which is more than 400 billion metric tons. The wide gap between the two countries is mainly because China's emissions have mostly been produced in the past two decades. Since 2000, per capita CO emissions in China have roughly tripled. In comparison, per capita emissions in the west have noticeably dropped.

### **CARBON FOOTPRINTS IN INDIA -**

India, being home to 9th out of 10 world’s Most Polluted cities, is facing a serious pollution problem. In one way or other, everyone contributes to the greenhouse gas emissions either by the way we travel, the food we eat, the amount of electricity we consume and many more. There is almost 10-fold increase in human’s carbon footprint since 1961.

### **GREENHOUSE GAS EMISSIONS IN INDIA -**

Among the various economic sectors of the country, the electricity and heat sector accounts for the largest share of greenhouse gas emissions in India, at roughly 37 percent.

Greenhouse gases such as carbon dioxide, methane, and nitrous oxide absorb infrared radiation and trap heat and keep the earth's surface warm.

### **COAL EMISSIONS -**

One of the main reasons for India's high emissions is the country's reliance on coal, the most polluting of fossil fuels. In 2021, India's CO emissions from coal totaled more than 1.8 billion metric tons. This represented more than 70 percent of India's total emissions that year.

### **CO EMISSIONS IN INDIA 1970-2021 -**

Per capita carbon dioxide (CO ) emissions in India have soared in recent decades, climbing from 0.39 metric tons in 1970 to a high of 1.9 metric tons in 2021 (by Ian Tiseo,2022). This was an increase of nearly 10 percent in comparison to 2020 levels, when total CO emissions in India plummeted following the outbreak of COVID-19.

### **PERSONAL CARBON FOOTPRINT**

One's personal carbon footprint is what he/she leaves behind as a result of moving about, consuming, eating and using resources like energy. Environmental NGO The Nature Conservancy estimates that each inhabitant on the planet produces an average of almost four tons of CO<sub>2</sub> every year, while in countries like the United States this amount is up to four times that per person and per year.

### **FACTORS RESPONSIBLE FOR CARBON FOOTPRINT -**

The major contributors to carbon footprints are: food, consumption, transportation, and household energy.

**FOOD** is a major contributor to carbon footprints, and meat in particular is an issue. Livestock is responsible for a significant amount of greenhouse gas emissions, and beef is one of the biggest contributors. One kilogram of beef has the same amount of emissions as driving your car about 160 miles. Completely eliminating meat is not necessary, but reducing meat intake helps lower your carbon footprint. Transportation of foods, pesticide use, and purchasing food out of season also contribute to carbon footprints. Processed foods have higher emissions than fresh food as it includes transportation, production in factories, and additional packaging.

**HOME ENERGY** consumption is a major contributor, as energy inefficient homes waste significant amounts of energy through poor insulation, energy inefficient appliances, drafts due to improper sealing, and excessive water use. A main contributor within the home is poor insulation, as heat leaves the house quickly.

**CONSUMPTION**, including clothing, footwear, and household and personal goods all account for a significant amount of an individual's carbon footprint because of these items all have associated emissions from gathering materials, production, and transport.

In addition, **transportation** significantly contributes to a carbon footprint simply because

driving cars is polluting. Group transportation like trains or buses pollute less per person, but still have emissions that are associated with them.

### **HOUSEHOLD CARBON FOOTPRINT CALCULATOR -**

Many of our daily activities cause emissions of greenhouse gases. For example, we produce greenhouse gas emissions from burning gasoline when we drive, burning oil or gas for home heating, or using electricity generated from coal, natural gas, and oil. Greenhouse gas emissions vary among individuals depending on a person's location, habits, and personal choices. For example- The quantity of greenhouse gas emissions from your home electricity use depends on the types of fuel your power plant uses to generate the electricity and the amount you use. The quantity of greenhouse gases emitted from your furnace and boiler depends on the efficiency of these items, the size and insulation of your house, and the amount and type of fuel used.

The quantity of emissions from your car or truck depends on how much you drive, what your vehicle's fuel efficiency is, and how you drive (e.g., the amount of time spent idling in traffic). In addition, the more recycling you do will reduce the amount of waste sent to landfills, as well as the greenhouse gas emissions that result from processing of raw materials.

Many of our daily activities - such as using electricity, driving a car, or disposing of waste - cause greenhouse gas emissions. Together these emissions make up a household's carbon footprint.

The calculator [wwwhttps://.epa.gov/ghgemissions/household-carbon-footprint-calculator](https://www.epa.gov/ghgemissions/household-carbon-footprint-calculator) estimates your footprint in three areas: **home energy, transportation** and **waste**. Everyone's carbon footprint is different depending on their location, habits, and personal choices. For a more accurate estimate, gather ones utility bills (electricity, natural gas, fuel oil, propane) to calculate average use over a year. Car rated fuel efficiency can be found at **fueleconomy.gov**, or calculate car's actual efficiency.

### **CO2 EMISSION CALCULATOR FOR INDIA -**

CO2 emissions Calculator at <https://e-amrit.niti.gov.in/co2-calculator> helps in calculating the taillight emissions from a conventional **vehicle** as compared to an Electrical vehicle. It also calculates CO2 emissions abatement if a person switches from a conventional Vehicle to an EV.

### **CLOUD CARBON EMISSIONS FROM GOOGLE CLOUD USAGE CALCULATOR -**

One can view the gross, location-based emissions that derive from your Google Cloud usage, providing transparency into emissions associated with your cloud applications. Monitor gross cloud emissions over time by project, product, and region. IT teams and developers metrics suggests that can help them improve their carbon footprint. Include gross carbon emissions data in reports and disclosures. Reduce the gross emissions of cloud applications and infrastructure. The dashboard data summary gives a high-level overview of the gross carbon emissions from electricity associated with the usage of covered Google Cloud services for an account.

### **CO2 EMISSION CALCULATION AT HOME -**

Alexandra Shimo-Barry, author of “The Environment Equation,” has come up with a formula

that explains how to calculate your carbon footprint at home

- Multiply your monthly electric bill by 105
- Multiply your monthly gas bill by 105
- Multiply your monthly oil bill by 113
- Multiply your total yearly mileage on your car by 79
- Multiply the number of flights you've taken in the past year (4 hours or less) by 1,100
- Multiply the number of flights you've taken in the past year (4 hours or more) by 4,400
- Add 184 if you do NOT recycle newspaper
- Add 166 if you do NOT recycle aluminum and tin
- Add 1-8 together for your total carbon footprint

Keep in mind that an “ideal” carbon footprint (or a “low” footprint) is anywhere from 6,000 to 15,999 pounds per year. 16,000-22,000 is considered average. Under 6,000 is considered very low. Over 22,000 is high.

### **PERSONAL CARBON FOOTPRINT -**

One's personal carbon footprint is what he/she leaves behind as a result of moving about, consuming, eating and using resources like energy. Environmental NGO The Nature Conservancy estimates that each inhabitant on the planet produces an average of almost four tons of CO<sub>2</sub> every year, while in countries like the United States this amount is up to four times that per person and per year.

### **NEED TO REDUCE OUR CARBON FOOTPRINTS -**

The Nature Conservancy says that we all need to reduce our carbon footprints to less than two tons per year by 2050. The experts say that this is the best way to ensure that temperatures stop rising and don't reach the dreaded 2°C threshold, which would exacerbate climate change and transform it into an irreversible problem.

Reducing carbon Footprint should be the foremost of our responsibilities and contribution towards the environment. Every person can do one's bit to alleviate emissions. Lowering individual carbon footprints from 16 tons to 2 tons is not easy. By making small changes to our actions, like eating less meat, taking fewer connecting flights and line drying our clothes, we can start making a big difference. Here are some of the most effective means to reduce one's carbon footprint:

- For short distances, one should either walk or ride bicycle to avoid carbon emissions completely. Similarly, Carpooling and public transportation should be encouraged to reduce CO<sub>2</sub> emissions
- Energy efficient appliances should be used to reduce CO<sub>2</sub> emissions. For instance, CO<sub>2</sub> emissions from traditional incandescent bulb is 8 times more than that of LED bulb. Similarly, refrigerators and ACs with better ‘Star Ratings’ can help bring down the emissions

- Forests are called the lungs of our planet for a reason. A tree absorbs kilos of CO<sub>2</sub> from environment every year. More and more plantation drives should be carried out by local communities and deforestation should be discouraged
- 3R's principle of Reduce, Reuse and Recycle should be followed. Reducing the need to buy new products, encouraging reusing existing ones as well as recycling the used ones can considerably bring down our emissions. For instance, recycling one tonne of glass bottles prevents more than 300kg of CO<sub>2</sub> emission
- Cleaner fuels like CNG, LPG, hydrogen fuels, electric vehicles can bring down CO<sub>2</sub> emissions from transportation tremendously
- Products with loads of unnecessary plastic packaging should be discouraged as the waste generated fills the landfill sites and pollutes environments
- Going solar, as outlined by government's recent policies, will go a long way in bringing down CO<sub>2</sub> emissions
- switching off lights and other appliances when not required is the least we can do to contribute towards environment

It is each and everyone's responsibility to implement these little acts in our daily lives to do our bit for the environment. It will go a long way to reduce the damage being done to our environment and protecting it for the future generation.

## **CARBON NEUTRALITY**

Carbon neutrality is achieving net zero carbon emissions by individuals, organizations, businesses etc. It is done by measuring amount of carbon released and compensating it by preventing equivalent amount of emission from happening somewhere else, or buying enough carbon credits to make up the difference. For instance, a corporation may plant trees in different places to offset the electricity it consumes. Carbon neutrality aims at achieving a zero carbon footprint. All those organizations and individuals seeking carbon neutral status entail reducing and/or avoiding carbon emissions first so that only unavoidable emissions are offset.

## **CARBON NEUTRAL: CATALYST FOR A 1.5°C FUTURE -**

By 2030, millions of inclusive jobs have been created globally in an economy rapidly gearing towards carbon management, low carbon industry and carbon sequestration. This opens new employment opportunities for those entering the jobs market, and also allows significant reskilling for those previously employed in less sustainable industries. Becoming carbon neutral has been a long process, with carbon management forming a core part of our sustainability agenda for more than 10 years.

## **STEPS PROCESS ALLOWS ONE TO ACHIEVE CARBON NEUTRALITY -**

It involves assessing the emissions of all business operations including offices, travel, work processes and supplies. One should have the skills and capacity to capture and track emissions



from across your business, including from suppliers and service providers. The international standard for carbon reporting, ISO 14064, provides guidance to accurately calculate carbon footprint.

- Measure own Carbon footprint/Carbon Emissions – Know how much and what is needed to reduce and offset.
- Reduce emissions – Put an Emissions Management Plan (EMP) in place.
- Make carbon neutrality an agenda item for board meetings with regular updates and communications via senior leaders to ensure it remains a constant priority.
- Embed ‘carbon champions’ to drive change from the bottom-up. Communicate goals, shared benefits and progress to raise awareness and encourage action across organisation
- Offset emissions that cannot reduce – The counteracting of carbon dioxide emissions with an equivalent reduction of carbon dioxide in the atmosphere via fully verified offset projects.
- Certification from external bodies provides assurance that your approach and methods meet best practice standards, are comprehensive and thorough.
- Sharing emissions data with colleagues, including information about per capita carbon footprints across the business, enables one to challenge them to cut their impacts further, and make suggestions.
- It’s important to collaborate with all the organisations that affect or supply the business to find new ways to reduce carbon.
- Offices can switch to renewable energy.
- Use car rental firms that offer preferential rates on hybrid or electric vehicles.
- Growing microalgae as some microalgae are attractive candidates for their higher lipid productivity can be used as biodiesel feedstock. Biofuel is a renewable source of energy and considered as ‘carbon neutral’ fuel because the carbon emitted during burning is almost equal to the carbon absorbed during photosynthesis. The large scale production facilities are necessary to capture carbon-dioxide (CO<sub>2</sub>) emissions from burning of fossil fuel.

## **CARBON NEUTRAL CERTIFICATIONS OF EMISSION REDUCTION UN CERTIFICATION**

Offsetting emissions with Certified Emission Reduction units (CERs), one chooses to take climate action through a process which is overseen by the United Nations. One purchases CERs that are issued from trustworthy climate-friendly projects called Clean Development Mechanism (CDM) projects. Carbon Neutral Certification provides organizations the credibility to illustrate their emission reduction efforts. It helps communicate product’s resource efficiency, drives sales, builds strong brand image and most importantly helps in cost reductions. CDM projects take place in developing countries and contribute to their sustainable development. Each project goes through a strict and thorough vetting process.

## **CERTIFICATION BY NATIONAL CARBON MANAGEMENT ASSOCIATION, INDIA**

NCMA is a national level non profit organization registered with “NITI Aayog, Government of India in association with National Informatics Centre to bring about greater partnership between government & voluntary sector (NGO) and foster better transparency, efficiency and accountability”.

Carbon Neutral Certification by National Carbon Management Association (NCMA) recognizes an organization’s greenhouse gas (GHG) emissions responsibly. Through this recognition, NCMA confirms that the organization recognizes the problem of climate change and is sincerely working towards curbing emissions. NCMA help and support Indian organizations to become a “Carbon Neutral Company” under the Carbon Offset Standard. Its Carbon Offset program is recognized and valid in 187 countries including India. Certification offers real advantages:

- Companies can brand themselves as ‘Awarded Carbon Neutral Company’ by NCMA.
- Improve corporate image and public relations.
- Generate revenue and increase market share by differentiating products and services with a powerful statement of environmental credentials.
- Tax benefit as per 80G

## **CONCLUSION**

The trace of the greenhouse gases produced by human activities are known as the carbon footprint. This environmental indicator measures both direct and indirect emissions of compounds like methane (CH<sub>4</sub>), nitrogen oxide (N<sub>2</sub>O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF<sub>6</sub>) and, above all, the most abundant and most important contributor to global warming since 1990: Carbon dioxide (CO<sub>2</sub>). The World Meteorological Organization (WMO) says that the concentration of greenhouse gases in the atmosphere reached a record high in 2019 and that today's levels of atmospheric CO<sub>2</sub> are comparable to those of more than three million years ago, when the earth's thermometer marked a temperature about 3°C higher and sea levels were 10 to 20 metres higher than they are today. According to the Global Footprint Network, the carbon footprint has not stopped growing. In fact it has increased elevenfold since 1961 and now accounts for 60 % of man's total impact on the environment. More often than not, we’re not aware of how our daily actions and decisions contribute to a massive carbon footprint as part of economic and industrial development. Unbeknownst to us, we’re held responsible for the significant shifts in the global climate ecosystem. For promoting people-centered sustainable development by innovating through research, by developing models, demonstration, policy advocacy and project implementation. People are increasingly seeking to adopt carbon neutral (Eco-Friendly) lifestyle because 70% people have “personal experience” of global warming. Buying product and services from a Carbon Neutral Company makes a concrete contribution to climate protection. We are the only ones who can reverse the damage to ensure a prosperous future for the next generations.

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# *Chapter 15*

## **SUSTAINABLE ECONOMIC GROWTH NEED, AGENDA, INITIATIVES**

**HIMANI  
JAHNVI SHARMA  
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### **INTRODUCTION**

“Humankind has learned it the hard way that economic growth and sustainable development should go hand in hand.”

Compound economic growth is calculated in terms of Gross National Product and Gross Domestic Product. An economy operates in the ecosystem that supplies factors of production which speedup economic growth namely, land, natural resources, labour and capital. An augmentation in the levels of any of these factors generate economic growth.

Sustainable development concerns to the development that meets the need of present without disconcerting the capability of future generation to meet their own needs. Economic growth that thrives to fulfill human needs along with sustaining natural resources for future generation is called Sustainable Economic Growth.

We live in the 21st century or the era of Gen-Z as we call it, where technology and lifestyle transforms faster than coronavirus would produce a new mutant. It is every country’s target to achieve new levels of economic growth. The alarming increase in the rate of global population coupled with growing demands of natural resources, is screaming for the resources to be judiciously utilised. The needs of future generations should be kept in mind as we exploit the natural assets.

During Rio de Janerio Council Meeting in 2012, all UN members endorsed the Sustainable Development Goals agenda. A concept of green economy in the context of sustainable development and poverty eradication was proposed.

As per a report by Global Footprint Network India has the world’s third largest ecological footprint. India has made a number of attempts to enforce the concepts of sustainable development. A flexible goal of generating 500 GW of renewable energy by 2030. Many other initiatives including AMRUT and HRIDAY have been launched along the idea of sustainable economic growth.

### **ECONOMIC GROWTH**

#### **What Is Economic Growth?**

The increase in the production of economic goods and services in one period of time

compared with a foregone session is known as economic growth. It can be measured in nominal or factual (adjusted to remove hike) terms. Conventionally, aggregate economic growth is calculated in terms of gross national product (GNP) or gross domestic product (GDP), although substitute quantities can sometimes be used.

### **Fundamental Points:**

1. Economic growth is a hike in the production of goods and services in an economy.
2. Economic growth can be contributed by increment in capital goods, labor force, technology, and human capital .
3. Economic growth is generally computed in terms of the enhancement in aggregated market value of additional goods and services produced, using approximation such as Gross Domestic Product.
4. There are four phases of economic growth namely - expansion, peak, contraction and trough.
5. Tax cuts are usually less effectual in provoked economic growth than they are high in government expending.
6. If the benefits of economic growth go only to a noble group, then it is not likely that the growth will be sustainable.

### **UNDERSTANDING ECONOMIC GROWTH:**

Generally, but not always, aggregate gains in production correspond an increasing average marginal productivity. This leads to a hike in wages, prodding consumers to tone up their expenses and purchase more, which means a better standard of living and higher substantial quality of life.

In economics, growth is usually established as a function of physical capital, human capital, labor force, and technology. In layman terms, any increment the quantity or quality of the working age population, the tools that they have to work with, and the plan of action that they have to execute labor, capital, and raw materials, will lead to a higher economic output.

### **PHASES OF ECONOMIC GROWTH:**

The economy moves through different periods of activity. This movement is called the “business cycle.”

It consists of four phases:

**Expansion** – During this phase employment, income, industrial production, and sales all increase, and there is a rising real GDP.

**Peak** – This is when an economic expansion hits its ceiling. It is in effect a turning point.

**Contraction** – During this phase the elements of an expansion all begin to decrease. It becomes a recession when a significant decline in economic activity spreads across the economy.

**Trough** – This is when an economic contraction hits its nadir.

## How to Measure Economic Growth:

The general measure of economic growth is the real GDP. This is the total value of everything, both goods and services, produced in an economy, with that value adjusted to remove the effects of expansion. There are three different methodology for looking at real GDP.

1. Quarterly growth at an annual rate – This looks at the change in the GDP from quarter to quarter, which is then compounded into an annual rate. For example, if one quarter's change is 0.3%, then the annual rate would be extrapolated to be 1.2%.
2. Four-quarter or year-over-year growth rate – This compares a single quarter's GDP from two successive years as a percentage. It is often used by businesses to offset the effects of seasonal variations.
3. Annual average growth rate – This is the average of changes in each of the four quarters. For example, if in 2022 there were four-quarter rates of 2%, 3%, 1.5%, and 1%, the annual average growth rate for the year would be  $7.5\% \div 4 = 1.875\%$ .

GDP, the prominent way to measure economic growth, is calculated by adding up all of the money spent by consumers, businesses, and the government in a given period.

### **The formula is:**

**GDP = consumer spending + business investment + government spending + net exports.**

There are alternatives to GDP. For example, the World Bank uses gross national income per capita, which includes income sent back by citizens working overseas, to measure economic growth, classify countries for analytical purposes, and determine borrowing eligibility.

## **1. SUSTAINABLE DEVELOPMENT:**

Sustainable development is development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs. Thus, it takes into account both the present and future generations without over-exploitation of natural resources and environmental degradation.

Features of Sustainable Development:

1. Sustained Rise in Real per Capita Income : There should be a sustained rise in real per capita income and economic welfare on extended basis.
2. Judicious Use of Natural Resources : Sustainable development simply means that natural resources should be judiciously used in a manner such that they are not overexploited.
3. Perpetuating the natural resources for future generations : Sustainable development aims at making use of natural resources and environment for raising the existing standard of living in such a way as not to abate the ability of the future generations to meet their own needs.

### Sustainable Development Goals

The documentary screened at the Rio+20 conference – “Future We Want” presented the idea of post 2015 development agenda. Sustainable development Goals (SDGs) is an intergovernmental

agreement formed to act as post 2015 Development agenda, its predecessor being Millennium Development Goals. It is a group of 17 goals with 169 targets and 304 indicators, as put forward by the United Nations General Assembly's Open Working Group on Sustainable Development Goals to be achieved by 2030. After negotiations, agenda titled "Transforming Our World: the 2030 agenda for Sustainable Development" was adopted at the United Nations Sustainable Development Summit. SDGs is the outcome of Rio+20 conference (2012) held in Rio De Janeiro and is a non-binding document.

17 Sustainable Development Goals

SDG 1: No Poverty

SDG 2: Zero Hunger

SDG 3: Good Health and Well-being

SDG 4: Quality Education

SDG 5: Gender Equality

SDG 6: Clean Water and Sanitation

SDG 7: Affordable and clean energy

SDG 8: Decent Work and Economic Growth

SDG 9: Industry, innovation and infrastructure

SDG 10: Reduced inequalities

SDG 11: Sustainable cities and communities

SDG 12: Responsible production and Consumption

SDG 13: Climate actions

SDG 14: Conserve life below water

SDG 15: Protect the life on land

SDG 16: Peace, justice and strong institutions

SDG 17: Partnerships for the goals

#### **4. Sustainable Economic Growth:**

Sustainable economic growth means maintaining growth without creating economic troubles or complications. It's the practise of supporting long-term economic growth without depleting resources. If you're interested in the factors that affect sustainable development and economic growth, it may be helpful to understand what it is and why it matters. In this article, we define 'What is sustainable economic growth', its objectives and its impact on living standards and the environment. Economic development that aims to meet the population's needs whilst protecting natural resources and the environment. It involves monitoring and managing these resources to ensure they remain accessible to future generations. It means maintaining an economic growth rate that doesn't generate price pressures, doesn't deplete resources and doesn't significantly damage the environment.

Economic growth is when the gross domestic product (GDP) increases over a particular duration. Sustainable growth means preserving the growth rate without triggering other economic problems. Rapid growth may deplete resources, stimulate environmental problems and

fuel global warming.

Sustainable development practices help to conserve natural resources. The economy depends prominently on trade, much of which relies on natural resources to produce goods or provide services. This includes water, waste, energy and food. Sustainable growth depends on green growth, sustainable development and non conventional energy strategies.

Sustainable growth rate: benefits and challenges

### **Green growth**

While green growth doesn't replace sustainable development, it supports more sustainable growth. Green growth strategies aim to ensure natural resources can sustainably realise their economic potential. These strategies include:

- **Productivity incentives:** Encourage greater efficiencies in the use of natural resources, waste reduction and energy consumption.
- **Boost investment:** Increase investor trust by more precisely predicting how governments deal with major environmental issues.
- **New markets:** increase demand for green goods and services in new markets.
- **Green taxes:** Increase revenue by collecting green taxes and eliminating environmentally harmful subsidies.
- **Reduce risks:** Develop strategies to prevent environmental damage.
- **Improve infrastructure:** Introduce technologies to increase efficiencies in the infrastructure that deliver water and energy and transports goods to communities.

### **SUSTAINABLE DEVELOPMENT**

There are ongoing debates about whether sustainable development policies create employment, reduce poverty or bankrupt businesses once they enforce the policies. It's possible to segregate environmental issues into two categories. Protection, which includes protecting land and water resources, and Regulation, which includes prohibiting deforestation and regulating toxic and hazardous waste disposal. There are three core areas of sustainable development:

**Environmental:** Previously regarded as the main reason for sustainability, environmental issues are now integrated into the corporate world.

**Economic:** This can combine sustainable practices, technology and revenue-earning activities.

**Social:** This focuses on health, education and quality of life.

**Related:** Economics of growth and development: relationship defined

### **RENEWABLE ENERGY**

Renewable energy comes from natural resources. These resources are self-replenishing and produce little or no harmful emissions. The aim of renewables is to replace fossil fuels, such as coal, oil and gas, that are non-renewable and produce harmful greenhouse gases . The expanding renewable energy sector helps generate many jobs with its constantly developing technologies.



## **WIND POWER**

Onshore and offshore wind farms generate electricity by harnessing wind power. The system converts kinetic energy into electric energy and feeds it into the national grid. Technology has evolved over the last few years to maximise electricity production, with taller turbines and larger blades.

## **SOLAR ENERGY**

Sunlight is one of the most freely available energy resources. Solar panels capture sunlight and generate electricity using photovoltaic technology. Solar energy can deliver heat, cooling, natural lighting, electricity and fuel for many applications. The manufacturing costs of solar panels have dropped significantly over the last decade, making them more affordable, often the cheapest form of electricity, with a lifespan of approximately 30 years.

## **HYDROELECTRIC POWER**

Hydropower uses tidal, flowing or falling water, such as dams and waterfalls, to generate electricity. Underwater turbines and a generator convert the energy into electricity, and transformers convert it to a higher voltage for long-distance transmission to the national grid. While energy production is more environmentally friendly than fossil fuels, the infrastructure required may negatively affect the ecosystem.

## **NEED OF THE HOUR**

Sustainable growth means catering more productive and reproductive potential for next generations. A robust economy means people have more disposable personal income to buy more products, build a big house, go on vacation or improve their way of living in other ways. This boosts many industries, including manufacturing, housing and travel and tourism. Conserving or replenishing resources may help a country to reduce its imports and increase its exports. All of this adds up to a country's GDP.

Efficient recycling programmes reduce ground and water contamination and the resulting clean-up costs. Reducing carbon emissions improves air quality. A healthier population may contribute to a more efficient workforce, lower healthcare costs and a better quality of life.

Sustainable economic growth is pursuit of economic development that attempts to fulfill the needs of people while maintaining natural resources in a sustainable manner, so they will be available for future generations. Most conventional economists don't believe sustainability is a problem because technology can help replace natural resources, and present prices don't indicate a problem of scarcity. Ecological economists deny and debate that the way price is measured in an economy doesn't mirror the true costs. Externality, or costs that others have incurred without agreement, is also a factor to consider. Also, they argue that you still need natural resources to produce the very manufactured resources traditional economists claim can replace natural resources. Finally, these economists argue that the whole idea of growth needs to be reassessed to take into consideration the true cost and outcomes of production, as well as whether the growth leads to well-being.

## **WHAT IS THE AIM?**

1. Sustain per capita economic growth in accordance with national circumstances and, in

particular, at least 7 per cent gross domestic product growth per annum in the least developed countries

2. Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labour-intensive sectors. Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small- and medium-sized enterprises, including through access to financial services
3. Improve progressively, through 2030, global resource efficiency in consumption and production and endeavour to decouple economic growth from environmental degradation, in accordance with the 10-year framework of programmes on sustainable consumption and production, with developed countries taking the lead.
4. By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value.
5. By 2020, significantly reduced proportion of youth not in employment, education or training.
6. Take immediate and effective measures to eradicate forced labour, end modern slavery and human trafficking and secure the prohibition and elimination of the worst forms of child labour, including recruitment and use of child soldiers, and by 2025 end child labour in all its forms.
7. Protect labour rights and promote safe and secure working environments for all workers, including migrant workers, in particular women migrants, and those in precarious employment.
8. By 2030, devise and implement policies to promote sustainable tourism that creates jobs and promotes local culture and products.
9. Strengthen the capacity of domestic financial institutions to encourage and expand access to banking, insurance and financial services for all.
10. A Increase Aid for Trade support for developing countries, in particular least developed countries, including through the Enhanced Integrated Framework for Trade-Related Technical Assistance to Least Developed Countries.
11. By 2020, develop and operationalize a global strategy for youth employment and implement the Global Jobs Pact of the International Labour Organization.

## INITIATIVES TAKEN

- **The Stockholm Conference, 1972** was the **first step** towards putting environmental concerns on the global agenda.
- It leads to declaration of the Stockholm Conference which contained **principles** and an **Action Plan** containing recommendations for environmental policy.
- **UNEP** was established in 1972 to serve as a fuel in developing and harmonizing an environmental focus in the programmes of different organizations.
- **The Earth Summit, 1992:** This was a direct consequence of the **Brundtland**

**Commission's Report.** It was conducted in Rio de Janeiro. The conclusions of the conference were the following documents:

1. The Framework Convention on Climate Change (UNFCCC)
  2. The Convention on Biological Diversity
  3. The Statement on Forest PrinciplesThe Rio Declaration
  4. Agenda 21
- Kyoto Protocol,1997
  - **Rio +10, 2002: A 10-year assessment** of the Rio outcomes (Rio +10) took the shape of the World Summit on Sustainable Development (WSSD) held in Johannesburg.
  - **Ramsar Convention, 1971** it is an intergovernmental treaty to recognize and conserve wetlands.
  - The World Heritage Convention, 1972: It identifies and conserves the world's cultural and natural heritage. It makes up a list of 'heritage sites', which are cultural, natural or mixed areas of '**outstanding universal value**' and therefore need to be preserved for all destruction .
  - Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1973
  - Convention on the Conservation of Migratory Species of Wild Animals (CMS), 1979
  - Vienna Convention for the Protection of the Ozone Layer, 1985
  - Montreal Protocol on Substances that Deplete the Ozone Layer, 1987
  - Basel Convention, 1989
  - Convention on Biological Diversity,1992
  - United Nations Convention to Combat Desertification,1994
  - Rotterdam Convention,1998
  - Stockholm Convention on Persistent Organic Pollutants,2001
  - Global Tiger Forum,1993
  - International Whaling Commission,1946
  - Minamata Convention,2013
  - Climate change mitigation strategies: Carbon sequestration, Carbon sink,Carbon Credit, Carbon trading, Carbon offsetting, Carbon Tax, Geo-engineering.
  - United Nations Environment Programme (UNEP)
  - UN Commission on Sustainable Development (CSD)
  - United Nations Convention on the Law of the Sea (UNCLOS)
  - Climate Finance Architecture: Green Climate Fund (GCF), Adaptation Fund AF) and Global Environment Facility (GEF)
  - Reducing Emissions from Deforestation and Forest Degradation (REDD) and REDD+
  - Paris Agreement 2015
  - The Clean Development Mechanism is a way to reduce greenhouse gases (GHGs) emissions through efficient and sound technologies.
  - Global Alliance for Climate-Smart Agriculture (GACSA)
  - Partnership for Action on Green Economy (PAGE)
  - Sustainable Development Goals (SDGs)
  - To reconcile the assertion of 'sovereignty', by the member states with the growing

environmental interdependence and the need for concerted action.

- For eg: Overcoming the North-South divide is one of the major hindrance facing the international environmental protection regime.
- The ‘Northern’ world has just over 20% of the world population but consumes
- 80% of the world’s energy; on the other hand, the ‘Southern’, comprises of the
- developing nations of the world is still scuffling to provide for the basic needs
- for its population.
- Methods to observe and regulate global commons (Oceans, Space and Antarctica). Being nobody’s property may act as a disincentive for protection.
- **Glossary**
- AMV- Aggregate Market Value tells about the size of the company.
- Business investment- is the investment by private parties on physical capital.
- Consumers- entity who purchases goods and services for personal use.
- Economy- is the relationship between production and Consumption of products.
- GDP-Gross Domestic Product is the value of finalized domestic goods and the services produced within a national.
- GNP-Gross National Product is the value of all the finished goods and services owned by the citizens.
- Goods- are the substances, items and materials produced by the companies for its consumers.
- Government spending- it is the money spent by public sector for acquiring goods and services.
- Human capital- is the investment by human to the society in form of knowledge and skills they acquired throughout their life.
- Inflation - it is the rate of increment in prices over a given time.
- Labor Force- consists of the man power available in the country for work.
- Marginal productivity- it is the extra or the profit yielded per unit production.
- Noble group- is the section of society that enjoys superior intellectual or social or economic status.
- Per Capita Income- is the measure to determine the money earned each citizen in a nation.
- Services- is the help and Aid produced by the companies.
- Sovereignty- is the freedom from external control
- Tax- is the amount of money people are made to pay on their income and property to the government.

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## Chapter 16

### THE ROLE OF ORGANIC FOOD PRODUCTS TOWARDS ENVIRONMENTAL WELLNESS

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#### ABSTRACT

“**Environmental Wellness**” connect us with organic food products. Crops that are organically grown without any use of pesticides, fertilizers, any kind of synthetic herbicides or genetically modified organisms (GMOs) comes under organic food product. Food products grown through organic farming methods helps the environment to reduce the pollution, soil erosion, conservation of water enhances soil fertility and consumes less energy. Organically produced food products stimulates environmental wellness without leaving any toxic residue by replacing the conventional chemical fertilizers with natural alternatives that supports the human wellbeing the popularity of organic food products has been increased significantly but still it is less available in Indian food market. Many researchers have concluded that proponents of organic food have convinced that it is more beneficial to health and minimises the risk of diseases related to lifestyle such as overweight, cancers, heart attacks and many more. In India ‘Sikkim’ has managed to go 100% organic state. To be successful in Agri business, organic farming should create a balance between the cost it involved and its carbon footprints while taking into consideration the increasing demand by figuring out how to feed a growing population. The process of environmental wellness involves learning and contributing towards the health of the planet, establishing a sustainable lifestyle by protecting the natural resources and eliminating excessive waste. Environmental wellness plays active role in your community by creating awareness regarding 4R’s (reduce, reuse rethink, recycle) caring for energy conservation, eat locally produced food, increase the per capita income of local farmers and educating people on environmental issues. The purpose of this paper is to examine the current status of organic food products towards creating environment wellness the advantages and disadvantages of organic food products. Concluding, organic farmers, distributors and consumers should work together for formulation of well-established strategies for organic food products and provide a better place in environment.

*Keywords: Organic food products, ecosystem, biodiversity, organic farming environmental wellness*

## **INTRODUCTION -**

Environmental Wellness is all about creating clean, healthy, secure and safe surrounding. As per National Institute for Health, Environmental Wellness focused on avoiding injuries, chemical exposures and infection in our environment. It encourages us to live in harmony by taking actions for protecting the planet “Earth”. We are quite famous with the terms of going green, eco-friendly living, sustainable living, 4R’s (reduce reuse rethink recycle) and environmental sustainability. The consumers are ready to “Pay for the opportunity of buying green”. Environmental Wellness initiative influences our descendants and us to enjoy a healthy natural and high quality of life by keeping the environment clean and healthy. These programmes encourage customers to make good lifestyle choices and lead to better health. Organic food product induces people to be good steward of their own health. Environmental Wellness not only focuses internally on individual health but it also focuses externally on the health of the ‘Planet’. Marketers are very keen to sell organic food products with increasing awareness in issues related with environment, naturopathy and green world. Our environment has a big impact on our health and wellbeing. The India government, the WHO nearly all major medical association warns us about the risk of living in unhealthy environment air pollution water pollution have deteriorated the quality of air and unhealthy water at local level has direct impact on the health of human beings. When employees are showing “Kindness to the planet means kindness to others”, they learn to appreciate our resources to keep our air, water and land clean. By using organic food products, they are supporting local farmers, local product and local business in their area which results in making a local economy strong and reducing the transportation expenses and fuel. Customers who consume organically grown food are happier and more productive. As per Organic Food Production Act 1990, “Inside the provision of food that approaches from animal protein derived from animals, eggs, dairy category product the animal necessity is not by feeding them antibiotics for development hormones”. Organic food products are those that are environmentally secure, produced by using environmentally sound methods not through the help of modern scientific inputs such as chemical fertilizers, genetically modified organism (GMOs) not processed using irradiation, industrial solvents, chemical food additives and pesticides without depleting the natural resources and harming the biodiversity. Organic farming is majorly considered to be more sustainable alternative when it comes to production of food. The farming done through conventional methods has been severely criticised for the harm it has caused to biodiversity, increase in water pollution and depletion of natural resources due to heavy uses of synthetic fertilisers and pesticides in the environment.

## **NATURE HEALS, NATURE SOOTHES AND NATURE RESTORES -**

Environmental Wellness is a process of learning about and contributing to the health of the planet. By eating locally grown fruit food product it establishes a sustainable lifestyle by protecting the natural resources, eliminating pollutant and excessive waste by playing an active role in our community and creating awareness in our surroundings. By consumption of ‘organic certified’ food product enhances our health and insures future health of our community and the world. According to environmental studies, farming done through organic methods are less

damaging to the environment as compared with traditional agricultural method. Organic farming is one -of- a -kind technique that strikes a balance between consumer safety and environmental sustainability by developing a good client relationship with the consumers and protecting the environment. Organic farming methods includes holistic production system that involves no use of harmful chemicals, pesticides, fertilizers which result in less impact on environmental species. Soil health can be revived and yield growth can be achieved by this kind of farming which favour’s the nature through extensive use of biological control pesticides, organic material and microbial fertilizers. Research reveals that environment can increase or reduce our stress through consumption of organic food product which in turn impact our bodies. What you are consuming at any moment is changing not only your mood, but how your nervous system, endocrine and immune systems are working. Stress from unpleasant environment can make us feel helpless sad depressed it elevates our blood pressure, heart rates, suppresses our immune system and weakens our muscles. Exposure to nature, viewings their greenery of nature reduces our stress hormones and contributes to physical wellbeing because human’s find food inherently interesting, we can naturally focus on what we are experiencing by are eating naturally grown organic foods. Humans have a natural tendency of feeling more connected towards nature. Nature restores the quality of soil by rejection of use of synthetic fertilizers for up to three years so that the soil can revive its lost nutrients through green manures. Weeds and pest are controlled with organically approved herbicides and natural pesticides. Organic food products are free from artificial colours, preservatives, flavouring substances and genetically modified organisms (GMOs).



**Figure: Elements of Environmental Wellness**

**PEOPLE, PLANET, PROFIT**

“Toxic” word often used to describe the food market in India and increasingly many parts of the world. Toxicity in the environment promotes obesity and eats away a healthy lifestyle.

Government is generating revenues by increasing the taxes on unhealthy food products and granting subsidies on organic foods. Zonal regulations imposed by the government can help to bring organic food products to supermarkets and low the limit on fast food restaurants in the areas. Awareness and communication policy can restrict advertising of unhealthy food product to youth on social media platforms and replace the unhealthy products with a healthy one. The environment in which we are live has significant influence on our feelings your mental conditions, productivity, emotional wellbeing and overall health. Planet health encompasses not just our own personal space but also geographical areas, bigger communities and the entire environment. Harmony with the nature is developed after consuming the foods that are grown through organic farming practices. It covers all the dimensions of the Environmental Wellness by developing healthy habits and positive impact on physical and mental health of human beings and other species.

### **HOW DOES CONSUMPTION OF ORGANIC FOOD CHANGES LIFESTYLE?**

Organic food products are rich in nutrition as it is produced through natural manures. “Nature is so smart to make food as medicines”. Through the following ways organic food changes in lifestyle:

- Constant intake of organic food products reduces the health problems.
- Organic food products are having fewer toxic chemicals and pesticides.
- Better in taste and quality.
- Organically grown vegetables and fruits are higher in vitamins content.
- Consuming organically grown fruits and vegetables could increase your antioxidant levels by 20% to 40% making you live long and healthy.
- Grown on certified organic farms without GMOs.
- Boost immunity system and reduce the risk of cancers.

### **OUTLOOK OF INDIA ORGANIC FOOD MARKET**

- Organic food market of India stood at the value of USD 1238 million in 2022 and it is expected to grow at CAGR of about 22% in the forecasted period of 2022 and 2028 then it would it would reach at a value of about USD 4082 million by 2028.
- The major market drivers of organic food industries include rising disposable income, increasing population, rising health and consciousness, the consumer spending on the health and wellness products.
- The major regional market of organic food products is in Assam, West Bengal Tamil Nadu, Kerala and Karnataka.
- The leading players of organic food product market are Suminter India organics, Nature Bio foods Ltd, Organic India Pvt Ltd.
- The dominant product of this industries are organic beverages, meat, poultry, dairy, spices, pulses cereals and food grain and fruits and vegetables.

The major channels of distribution for the organic food products includes supermarkets and



hypermarkets, specialty stores, convenience stores and E-commerce. In India, organic food market is a niche market which is expected to see a wider penetration in the coming future years. Due to growing incidents of food toxicity through adulteration the demand for organic food product is anticipated to rise in the future coming years. E-commerce industries also appeals to the potential consumers by offering lucrative offers on social media platform .In major metropolitan towns companies offering organic food products is also opening a small kiosk ,for increasing its market growth .The demand for organic tea in beverages have the greatest appeal, followed by pulses and milk products Government funding is also catalysing the market for organic food products in India by encouraging organic farming through financial assistance to farmers who are practicing organic farming under the various government schemes such as National Food Security Mission (NFSM), NMSA, Mission For Integrated Horticulture Development (MIDH) and Rashtriya Krishi Vikas Yojana ( RKVY).

### **ROLE OF ORGANIC FARMING IN ENVIRONMENTAL WELLNESS -**

In past few years our environment circumstances have observed massive destruction of environment. Humans reckless attitude and impulsive action have cost a lot to ecosystem and required to do the most dangerous in the next generation. There is an alarming call to preserve the nature and ecosystem quickly and efficiently. In the present scenario people liking organic agriculture have become the need of the hour rather than being secondary benefit main focus of organic agriculture is to grow crops healthier that maintains the strength of the soil unharmed. Organic food product provides enormous number of ecological benefits in biodiversity by opting and agriculture system that supports chemical free cultivation technique. The balance within the ecosystem is created by avoiding synthetic chemicals that promote protection of flora and fauna. As per journal Biological Conservation 2005, scientists have researched separate impact of organic and traditional farms on soil microbes, spiders, beetles, mammals, birds, earthworms among others. The result of the study is demonstrated that search living organisms are in abundance amount in organic farms. Organic farming practices prevents soil and water contamination. Avoiding the use of synthetic chemicals in natural farming techniques keep the risk of underground water and soil contamination away as compared to conventional farming methods due to extensive use of toxic chemicals in the ecosystem. Organic farming practices don't eliminate the whole vegetation from the crop in result more soil is attached with vegetation which prevents the wind from carrying the top most fertile soil layer and preventing the soil erosion in the ecosystem. Due to increase in carbon dioxide levels in environment lead to global warming, organically grown foods are locally distributed as a result less fuel and energy is used in distribution in transportation which automatically decreases the Co2 level thus organic food production helps in preventing the global warming. Through sustainable agriculture we are maintaining and sustaining the quality of environment, conserving natural resources and satisfying changing human needs. Organic food product farming method has slowed the soil contamination genetic erosion and water shortage, etc. Organic farming methods for cultivation crops are pollinated free, protect bees and wildlife. Farmers don't rely on non-renewable oil-based fertilizers and pesticides for cultivation of crops. Fewer greenhouse gas emission is released in atmosphere which results in greater biodiversity.

## **SIGNIFICANCE OF ORGANIC FOOD PRODUCTS DURING COVID -19 TIME-**

COVID-19 attacks person with suppressed immune system and people of under and over age. Plant based organic food increases the intestinal bacteria and overall gut biome health which is present in the body up to 85%. The phenolic acid present in organic food products is rich in antioxidant content which plays an important role in prevention of free radicals. Various kind of disease of in childhood age group like atopic eczema, allergy is prevented by consumption of organic foods. Omega 3, fatty acids, iron, antioxidants are more present in organic foods as compared to conventionally grown food items. Organic milk has reported high level of conjugated linoleic acid (CLA) which is beneficial for human health. The risk of health issues was less for the people consuming organic food products are more environmentally friendly, organic farming best commences from wildlife farmers, protection of ecosystem and finally to the end consumers. During the COVID-19-time people are more inclined towards organic food for the enormous benefits it offered like nutritive value, microbes' awareness, use of biotic compound in farming and are rich in antioxidant. In India there has been a paradigm shift post 2020 pandemic towards consumer to buy more organic foods. Beverages market particularly fruits and vegetables are highly influenced from organic farming. Many retailers all over the globe are adding more and more organic food products to their shelves due to the increasing demand of organic foods, they more accessible to consumers through speciality stores and retail outlets.

## **ADVANTAGES OF CULTIVATION OF ORGANIC FOOD PRODUCTS FOR ENVIRONMENTAL WELLNESS -**

- Sharp rise in health awareness- organic food products reduce the public health risk by minimising exposure to toxic chemicals on farm and in food, reduce soil and water contamination. Children are more vulnerable to pesticides present in conventionally grown food that has been now replaced with organic one's.
- Foods grown organically are naturally rich in nutrients such as iron, Vitamin C, phosphorus, magnesium with less exposure to nitrogen pesticides when compared to conventionally grown foods products.
- Foods which are organically ripened provides better taste as it is given more time in farms to grow in natural ways.
- Organically produced foods are rich in antioxidant content prevents the people from vision problems, diabetes, obesity, cancers. Organic meat, milk and dairy products have desirable amount of Omega 3 fatty acids may reduce the risk related to allergies.
- Soil nutrients are maintained without using inorganic fertilizers pesticides in soil. Consumers have also begun to understand the importance of consuming organic food for environmental wellness.
- Organic farming methods include natural farming techniques that are environmentallyfriendly. It helps in reducing the CO<sub>2</sub>, slows down the process of climate change and prevent the hazardous effect of global warming.

## MYTHS ABOUT ORGANIC FOOD PRODUCT

Organic food products are always the hot topic for discussion for the nutritional content and their demands to get fulfilled in all over the world. There are various invalid arguments which are raised against organic food products that needs clarification.

- **All organic labelling on food products is same-** in this case only the food products that has 95% of organic material are termed as 'organic'. If it is composed of only 70% of the organic ingredients then it will be termed as "Made with organic ingredients" label on the product.
- **Organically grown foods are costly-** this is a myth but in reality, naturally manufactured food may cause even less than conventionally grown food. Food grown through conventional practices have "sunk cost" attached to it as "health costs", remember our health is an investment not an expense.
- **Pesticides are not that much bad for health-** our body can't digest pesticides at all even after a long time of food ingestion not only they will survive in the body but also accumulates over the passage of time.
- **Feeding the entire world through organic farming practices-** this is a myth that organically grown crops need time and it can make a burning hole in the pocket of consumers due to its soar prices. Research has found that organically growing crops produce comparable yields to normal produce plus it enhances the quality of soil over the time. Research done through farming system trials, shows that organic 's can preserve biodiversity and Environmental wellness.
- **Organically grown food products are just creating a "market hype"** -people living in metropolitan cities believe that organic food products are just "marketing hype" or earning sufficient amount of cash in the beginning but they are all myth organic food are composed of nutritional values antioxidant that assist in opting for healthy lifestyle. They are grown as per government norms and standards as compared to inorganic food products.

## CONCLUSION

There is a strong need for climate friendly diet in our ecosystem. Our diet plays an important role in climate change as per UN Sustainable Development goals (SDGs) what people eat can prevent many deadly diseases. According to the reports published in EAT Lancet, "Transformation to healthy diets by 2050", it will require many dietary shifts like in consumption of fruits vegetables, pulses, grain should be doubled and the consumption of unhealthy diet items like intake of sugar, red meat, canned, processed food should be reduced to half. People diet should more comprised of plant-based food organically produced that improves the overall human health and confers to many environmental benefits on the ecosystem. Shifting towards a sustainable diet doesn't disrupt the plant growth pattern and allows them to grow at the pace organically that can be healthy in many aspects related to nutrition, economic, social and environmentally well. The report on climate change by Intergovernmental Panel on Climate Change (IPCC) elaborates the importance of plant-based diet, use of renewable energy, decrease

in air, water and land pollution, investing more in energy efficient appliances that can reduce CO<sub>2</sub> emissions. Nowadays, increase in vegan diet have significantly increased, they are environmentally friendly as they are produced by least amount of carbon emissions although they can be deficient in many vitamins and nutrients like vitamin b 12, iron, zinc, magnesium which are highly present in animal-based diet but vegan diets if carefully planned under the guidance of dietitians can help in achieving the nutrition required without harming many species on the planet. A well-planned organic diet can decrease the carbon footprints on the climate change and reduce the greenhouse gases emissions. Organically grown foods product are **'natural gift to us from Mother Nature'** as they have endless benefits. Consuming natural product itself is a delight for human beings. We can do better job by persuading our young generations to focus more on organic diets and helping people to adopt good environmental practice for enjoying a high level of wellness. Our little contribution will make to keep our planet clean, safe and peaceful place to live. We still have miles to go to make our future where sustainable practice and environmental wellness are the norms.

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