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STUDY OF BIOINDICATORS IN HUMAN ENVIRONMENT

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ABSTRACT :- Bioindicators are organisms, such as lichens, birds and bacteria that are used to monitor the health of the environment. The organisms and organism associations are monitored for changes that may indicate a problem within their ecosystem. The changes can be chemical, physiological or behavioural. Bioindicators are relevant for Ecological health. Ecological health can be viewed in terms of ecosystems, whereby structural and functional characteristics are maintained. Ecological health can be expanded to include many aspects of human health and well-being. Each organism within an ecosystem has the ability to report on the health of its environment. Bioindicators are used to: detect changes in the natural environment, monitor for the presence of pollution and its effect on the ecosystem in which the organism lives, monitor the progress of environmental cleanup and test substances, like drinking water, for the presence of contaminants. Specific physiological and behavioral changes in bioindicators are used to detect changes in environmental health. The specific changes differ from organism to organism. The use of organisms as bioindicators encompasses many areas of science. Wildlife conservation genetics is an example of how traditional approaches can be combined with emerging biotechnologies to improve accuracy, and to collect information not available through conventional methods. Wildlife conservation genetics combines traditional monitoring of wildlife populations, like raccoons, with the scientific discipline of genetics, to gain information about the health of ecosystems. Several biotechnology – based methods use microorganisms to test environmental health. Unlike traditional methods, biotechnology - based methods do not rely on observation alone but set out to create specific reactions that indicate the presence of a specific pollutant or an unwanted microorganism. In this way they are similar to traditional chemical analysis of environmental samples. In traditional bioassays, a bioindicator organism or organisms association are introduced to environmental samples, such as soil or water, and researchers observe any changes that occur as a result of exposure. These methods are based primarily on observation to detect changes. Bioindicators can be a measure, an index of measures, or a model that characterizes an ecosystem or one of its critical components. They are also a method of monitoring or detecting the negative impacts that industrial activity has on the environment. This information helps develop strategies that will prevent or lower such effects and make industry more sustainable. The role of bioindicators in sustainable development will help ensure that industry leaves the smallest footprint possible on the environment.

KEYWORDS:- Bioindicator, Human Environments, Quality, Criteria, Bioassys.

INTRODUCTION:-

Ecosystem monitoring is necessary to preserve and manage the natural environment. It can be carried out by an ecological indicator (Nguyen, 2007). Each organism within an ecosystem has the ability to report on the health of its environment. Bioindicators are used to: detect changes in the natural environment, monitor for the presence of pollution and its effect on the ecosystem in which the organism lives, monitor the progress of environmental cleanup and test substances, like drinking water, for the presence of contaminants. Biological indicators are living organisms, i.e., plants, animals, and/or microorganisms, which are exploited to detect pollutants in a given ecosystem. They explore the life span or residence time of pollutants integrating past, current, and future ecosystem status. They are supportive, objective, straightforward, applicable at various scales, and reproducible. Khatri and Tyagi (2015) emphasized the significance of caring about the natural factors interacting with biological indicators such as light, moisture, temperature, and suspended solids. Chemical (Saber et al., 2016a) and physical

(Zaghloul et al., 2019) pollutants indicators might oversight several irregular pollutant bursts. So, integration between biological, chemical, and physical pollutant indicators is tremendously demanded. Bioindicator is given to a living entity or group of organisms that shows the information, either based on the environment or a constituent of it (Wilkomirski, 2013). Naturally occurring biological indicators are regularly used to assess a given ecosystem detecting positive and negative changes.

USES, TYPES AND BIOLOGYCAL CRITERIA OF BIOINDICATORS-

Therefore, bioindicators are a numeric value derived from actual measurements of a pressure, state or ambient condition over a specific geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment. Key indicator criteria are: the bioindicator is useful, the bioindicator is objective, the bioindicator is transparent and reproducible, the underlying data is characterized by sound collection methodologies, data management systems to protect its integrity, and quality assurance procedures, data are available to describe changes and trends and the data are comparable across time and space, and representative for target population. In order to understand the health of the environment it is necessary to use indicators because ecological systems are too complex to measure fully (KBO, 2013). They occur in many habitats, reflect changes in other animals and plants, are sensitive to environmental change and have great resonance with the public (IUCN, 2010). Types of bioindicators and their uses include the following:

1) MICROBIAL INDICATORS –

Microorganisms can be used as indicators of aquatic or terrestrial ecosystem health. Found in large quantities, microorganisms are easier to sample than other organisms. Some microorganisms will produce new proteins, called stress proteins, when exposed to contaminants like cadmium and benzene. These stress proteins can be used as an early warning system; For example, microbial indicators can be used for testing water: Bioluminescent bacteria are being used to test water for environmental toxins. If there are toxins present in the water, he cellular metabolism of the bacteria is inhibited or disrupted. This affects the or amount of light emitted by the bacteria. Unlike traditional tests, this one is very quick-taking from five to thirty minutes to complete. However, it only indicates the presence of a toxin causing the change in the organism. The classification of the microbial biomass might be determined through microbial behaviors such as breathing, mineralization of C and N, bionic N2 fixation, and enzymes. Some microbial behavior, e.g., biomass-specific breathing, seems to be more sensitive than its single action or population rate (Aslam et al., 2012). There might also be some kind of "global regulation" metrics, e.g., biomass as a proportion of organic matter. Such methods could be built to test whether toxins without costly and long-running field routes change the natural ecosystem.

2) PLANT INDICATORS –

The presence or absence of certain plant or other vegetative life in an ecosystem can provide important clues about the health of the environment. Lichens, often found on rocks and tree trunks, are organisms consisting of both fungi and algae. They respond to environmental changes in forests, including changes in forest structures, air quality, and climate. The disappearance of lichens in a forest may indicate environmental stresses, such as a high levels of sulfur dioxide, sulfur-based pollutants and nitrogen.

3) ANIMAL INDICATORS –

An increase or decrease in an animal population may indicate damage to ecosystem caused by pollution. For example, if pollution causes the depletion of important food sources, animal species dependent upon these food sources will also be reduced in number. In addition to monitoring the size and number of certain species, other mechanisms of animal indication include monitoring the concentration of toxins in animal tissues, or monitoring the rate at which deformities arise in animal population. For example, invertebrates can be bioindicators. Aquatic invertebrates live in the bottom parts of waters. They are also called benthic macroinvertebrates, or benthos (benthic=bottom, macro=large, invertebrate=animal without a backbone) and make good indicators of watershed health because they: are easy to identify in a laboratory, often live for more than one year, have limited mobility and are integrators of environmental

condition. Also, frogs can be boindicators of environmental quality and change: Frogs are likely to be affected by changes that occur in terrestrial and freshwater habitats, and to be exposed to contaminants in air, sediment and water. This make them potential bioindicators of environmental quality and change. Reasons why frogs are particularly affected by changes and contamination include: most frogs spend time in fresh water as aquatic eggs and larvae, most frog spend time out of water as terrestrial immature and adults, frogs lay naked eggs and frogs have semi-permeable skin. Some bioindicators that are high on the food chain are most comparable to humans and most sensitive to stressors, but are often rare and difficult to study. Others that are at an intermediate trophic level may be consumed by humans, hence be directly relevant to human exposure. Indicator species that are lower on the food chain can be used to indicate potential damage to higher trophic level organisms within ecosystems, as well as to humans who consumed them. Three species that can be used to examine both ecological and human health include Mourning Doves, Raccoons, and fish (Burger et al. 1997, 1998, Kennamer et al.1998, Gaines et al.ms). These are useful because they are common, widespread, of interest to the public, and consumed by humans.

1. HOW DO BIOINDICATORS WORK?

Bioindicators that are developed specifically to assess human exposure (e.g.through the food chain) can also be indicative of the health of the organisms themselves (Burger et al.1997), and more generally of the health of the ecosystem (Wilson,1994). Specific physiological and behavioural changes in bioindicators are used to detect changes in environmental health. The specific changes differ from organism to organism. The use of organisms as bioindicators encompasses many areas of science. Wildlife conservation genetics is an example of how traditional approaches can be combined with emerging biotechnologies to improve accuracy, and to collect information not available through conventional methods. Wildlife conservation genetics combines traditional monitoring of wildlife populations, like raccoons, with the scientific discipline of genetics, to gain information about the health of ecosystems. Behavioural and population changes in a species can be observed by scientists, but physiologycal changes must be detected using specials tests. Bioassays require samples from organisms to detect changes in the environment. These tests may be used to ensure drinking water safety or to measure river health. In the future, as research identifies new ways to use microbes, these uses will expand to include testing of soil and air. Bioassays can be carried out in traditional ways and with new biotechnology derived methods.

2. TRADITIONAL BIOASSAYS

In traditional bioassays, a bioindicator organism or organisms association are introduced to environmental samples, such as soil or water, and researchers observe any changes that occur as a result of exposure. These methods are based primarily on observation to detect changes. Examples of traditional bioassays methods include the following:

- Measurement of plant root growth is suspected polluted environments and comparison of the measured growth rate against normal root growth rates;
- Exposure of microorganisms to an environment and observation of any changes in the organism related to toxin exposure, such as the presence of stress proteins produced when cells are exposed to harmful environmental conditions.

Biotechnology-Based Bioassays

Several biotechnology – based methods use microorganisms to test environmental health. Unlike traditional methods, biotechnology - based methods do not rely on observation alone but set out to create specific reactions that indicate the presence of a specific pollutant or an unwanted microorganism. In this way they are similar to traditional chemical analysis of environmental samples. DNA Microarray Technology:

- Using DNA microarray technology, environmental samples, such as water, are tested for the actual genetic material of an organism. This form of testing is used to detect dangerous microorganisms in the environment, such as E. coli bacteria in water;
- DNA microarrays are stamp-sized glass or silicon microchips that are embedded with thousands of single-stranded DNA or RNA. In this case, the DNA is that of microorganisms being tested for.

The microarrays are manufactured using samples of microorganisms. If the same types of microorganisms are present in the water sample, the DNA or RNA on the array will react with the complementary DNA or RNA of the microorganism in the sample. This identifies its presences in the sample. When these tests are fully developed, it will take as little as four hours to test for microbial presence in environmental samples, such as drinking water and soil. Traditional chemical-based tests take an average of 48 hours.

3. FLUORESCENCE IN-SITU HYBRIDISATION – (FISH)-

This is a method for detecting the presence of particular genes in sample. As a bioindicator, FISH can determine whether or not specific microorganisms are polluting certain areas. It does this by testing environmental samples for the presence of microbial genes. A fluorescent marker is attached to the DNA of the type of microorganism being testing. This marked DNA is now called 'probe. Environmental samples are fixed onto a slide, and the slide is exposed to the fluorescent DNA probe. If the polluting microorganism is present on the slide, its DNA will bind to the fluorescent probe, causing the slide to glow with ultraviolet light. Detection of this ultraviolet light by a special fluorescent microscope demonstrates the presence of polluting microorganisms in the sample.

Biotechnology and Bioindicators-

Biotechnology-based tests are being used to identify changes in indicator species to indicate the presence of pollutants in the environment. Many of the tests being developed are designed to detect pollutants in rivers and drinking water sources. Some of analyzed pollutants are: SO_2 Lead, Fluorine, Polycyclic aromatic hydrocarbons (PAH), Polychlorinated biphenyls (PCB), Polychlorinated dibenzodioxin (PCDD). SO_2 in the air enters as a gas or dibenzodioxin (PCDD). SO 2 in the air enter as a gas or in water solution and can cause damage. Chemical reactions of SO 2 create acids. Precipitation can transport these acids into the soil and trigger indirect damages, such as lack of nutrients and acid stress. Value limits for directing damaging effects on plants and clearly lower than for animals and humans. High sulfur dioxide concentrations lead to air pollution damages on coniferous trees, including non-specific chloroses, necrosis and growth inhibition.

Lead is a heavy metal and has special environmental relevance's because it is toxic. Leaded gasoline is still the main source. Most lead particles remain on the surface of leaves. Only a small amount becomes physiologically active and damage plants. This process can lead to accumulation in the food chain. Toxic effects for grazing animals or humans cannot be ruled out. Fluorine is released from various industrial processes, waste burning, and by fossil fuel energy production. Hydrogen fluoride damages in plants appear primarily as necroses on leaf edges (marinal) and tips(terminal). Fluoride is accumulated in plants, damages leaves and inhibits growth.

Polycyclic aromatic hydrocarbons (PAH) are emitted primarily as incomplete combustion products, such as from internal combustion motors and heating plants. This group has carcinogenic and mutagenic potential. Benzo(a) pyrene (BaP) is a leading component of polycyclic aromatic hydrocarbons. Polychlorinated biphenyls (PCB) PCBs enter the human organism primarily in the form of animal products , through accumulation along the food chain. Accumulation in plants seems to be of little phytotoxic significance. Great attention must be given to the exposure of the population to these substances , in view of their damaging effects on embryos and a well-founded suspicion of carcinogenic effects. Polychlorinated dibenzodioxine (PCDD) and polychlorinated dibenzofuran (PCDF) - the group known as dioxins' accumulate in the food chain. They primarily enter the human organism in foods containing animal fats. The behavior of this material in the environment as well as its toxicity for human is not yet sufficiently known. Bioindicator research is currently focused on developing more rapid and reliable tests for the presence of microorganisms in water and soil. Tests for drinking water are a special area of concern for both developed and developing countries. Although biotechnology – based tests currently exist for drinking water, there are still many pollutants that are not detectable. Scientists are busy to replace traditional methods with newer, faster, and more reliable tests based on biotechnology.

BENEFITS OF BIOINDICATORS-

- Bioindicators are biological assessment to monitor environmental pollution by their biological impacts on pollutants.
- Bioindicators have the potential to indicate the toxicity or harmful impact of any pollutants when physical or chemical methods are not applicable.
- A single species can be used as an indicator of any pollutants. No need to monitor whole community for biomonitoring.
- Economically viable alternative when compared with other specialized measuring systems.
- It directly monitors human health by maintaining link between the quality of human life and environment.

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CONCLUSION:-

Bioindicators can be a measure, an index of measures, or a model that characterizes an ecosystem or one of its critical components. They are also a method of monitoring or detecting the negative impacts that industrial activity has on the environment. This information helps develop strategies that will prevent or lower such effects and make industry more sustainable. The role of bioindicators in sustainable development will help ensure that industry leaves the smallest footprint possible on the environment. The benefits of bioindicators is that it uses a single species of any plant, animal or microorganism to make a conclusion regarding the increase level of any pollutants. Thus bioindicators monitors human health .The conclusion can be drawn that the bioindicators is dynamic tool for the assessment of the pollutants level and its toxicity degrading the ecosystem by the presence of different biotic factors present in the environment.

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