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Some Pollution indicators in Environment: A Review

[1] Ankita Kulshreshtha, [2]Jyoti Saxena
[1]Research Scholar, [2]Professor
[1, 2] Department of Chemistry,
[1, 2,] Institute for Excellence in Higher Education, Kaliyasot Dam, Kolar road, Bhopal, India, 462016
Email – [1]ankita.kuls@gmail.com, [2]jyotisaxena147@gmail.com

Abstract: *The various pollutants enter daily into environment and exert various kinds of stress on organisms and ecosystems. Therefore, it is necessary to understand early warning signals pollutions by living indicators that convincingly reflect adverse biological responses towards anthropogenic environmental toxins even at minute concentrations. Pollution indicators can be utilized at various scales, from the cell to the environmental level, for assessing the changes taking place in a specific biological community. All living organisms i.e. microbes, planktons, animals and plants are utilized to screen the health of the natural ecosystem in the environment w.r.t. pollution studies. They are used for assessing environmental pollution, health and bio geographic changes taking place in the environment by the specific changes. Major symptoms of pollution or any contamination of environment can cause loss of Biodiversity. Study of some living organism of natural flora and fauna that indicate environmental pollution occurs is discussed in this review.*

Key Words: *Environment, Pollution, Living Organism, Pollution Indicators.*

1. INTRODUCTION:

Environmental pollution is increasing day by day which affects the biodiversity directly or indirectly. Changes due to any contamination in ecosystem can easily understand by their responses by different flora and fauna. Environmental pollution indications are natural transform due to certain changes in any activity in nature and it is utilized to show the impacts of natural surrounding [1]. Living organism indicates changes in natural surroundings and environment due to the presence of contamination or pollutants which can affect the biodiversity of the environment by indication of negative or positive impacts [2].

Living organisms those indicate changes of environment such as, microorganisms, lichens, animal or plants which signals pollution with physiological and behaviour changes [3-4]. These all living organisms can be examined without any difficulty by environmental conditions of their habitat, activity and changes in surroundings were studied by [5-7]. Some conditions such as short-term stress or long-term events predict and alter by indentifying the variation in various species due to sudden change in environment [8].

Indicators are used to indicate air quality and locate sources of air pollution utilizing known as air "Pollution Indicator." A reliable and cost effective way to evaluate the changes due to pollution in the environment is possible by means of indication of living organism species. Selecting a specific indicator poses a real challenge, followed by its identification as well as relation with their particular applications. As a result, environmental, ecological, and biodiversity indicators fulfil their goal of monitoring environmental quality [9]. Pollution indicators demonstrate the changes in living systems of environment, whereas diversity coexists with the overall community of ecosystem for taxonomic groups of biodiversity indicators [10-11]. Environment pollution is one of the major changes in nature; therefore, this review study shall discuss the various pollution indicators in environmental.

2. POLLUTION INDICATORS IN ENVIRONMENT:

2.1 AIR POLLUTION INDICATORS:

Air Pollution indicator is containing a series of chambers, where the particulate matter and chemicals have been removed by a series of filters. Bio-indicator plants are very sensitive to a selected (toxic) chemical, they respond quickly with typical visible foliar symptoms to the presence of medium-to-low levels of the noxious agent; they are very cost-effective and represent a striking visual demonstration unit.

Lichen growth and health can assess many air pollutants and the value of these living organisms rather than manmade instruments for assessing sulfur dioxide levels is that they are inexpensive and give quick results. Lichens are especially useful in forestry to assess where conifers should be planted since conifers are affected by the same sulfur dioxide levels that cause lichen cover to decline. Lichens acting as bioindicator of heavy metals like (Pb, Cr, Cu, Cd, Ni etc) caused due to pollution from motor vehicles activites on roadside soils e.g. Xanthoria candelaria, Xanthoria elegans etc. Lichens are indicating changes due to air pollution by their presence, their habitat and certain changes in their growth

[12-14]. Due to their sensitivity to different factors of environment, lichens are considered to be the most appropriate biomonitors of air quality during last 30 years [15-16]. Lichens are considered the most reliable biomonitors according to their specific physiological, morphological and anatomical characteristics [17-18]. The possibility of transplanting healthy lichens into areas suspected of being polluted, and monitoring physiological parameters such as respiration and photosynthesis, to give a rapid indication of pollution levels is obvious.

Aerial or sub-aerial algae would also be ideal as indicators of air pollution because of ease of handling, range of species specific sensitivity which is greater than in higher plants and much quicker physiological responses to air chemistry than occur in high plants. Many of the cortecolous, lithophilous, epiphytic algae, liverworts and fern gametophytes are ideally suited as air biological monitoring organisms. Using both pollution tolerant and pollution sensitive species would be best for air quality indication. Especially suitable as test organisms in the Air Biomonitor are the microalgae found in both aerial and sub aerial habitats such as species of Chlamydomonas, Chlorella, Chlorococcum, Chlorosarcina, Chlorosarcinopsis, Gloeocystis, Chlorhormidium Pleurococcus, Stichococcus, Trebouxia, Chroococcus, Gloeocapsa, Nostoc, Oscillatoria, Schizothrix, and Scytonema and the diatoms- Navicula and Nitzschia etc.

Air pollutants are absorbed by Tillandsia usneoides, commonly called Spanish moss, is a relative of the pineapple (order Bromeliales, family Bromeliaceae, genus Tillandsia (air plant), and species usneoides) (Spanish moss). In fact, it is an epiphyte, a plant that gains all of its moisture and nutrients from the air (Arny). The thin trichomes (scales) that cover the whole plant, these trichomes play an important role in the absorption of moisture and nutrients from the air. The trachomas act as pumps, and draw moisture and dissolved minerals into the plants through the stomata (Arny). This indicates that whatever is present in the air including pollutants will be absorbed by the plants.

Spider Webs acts as an efficient traps of airborne particulates and provide a useful indicator for monitoring environmental pollutants because they are unexpensive and easy to collect and are widespread in urban areas and acts as best indicators of heavy metal pollution e.g. (Pb, Zn, Cu, Cd etc.) in air e.g. Achaearanea tepidariorum, Araneus ventricosus [19].

Bryophytes are powerful pollution indicators of air quality on the grounds that they have no roots, no fingernail skin, and acquire all their supplements from immediate introduction to the climate. Their high surface region to volume ratio further supports the theory of their use as a bio indicator, or supports their ability to capture contaminates from the air [20]. The roadside plant leaves can be measured by their exposure to air pollutants as well as their reaction as stressor against them, yet in an industrial area the response from several growing plants has been monitored biochemically and physiologically through proper investigation [21-26]. Plants are used as very sensitive tools for prediction and recognition of environmental stresses [27]. The herbs, shrubs and trees differ in their sensitivity levels to air pollutants and the sensitivity level is usually in the order of: herbs > shrubs > trees. Plants are efficient enough not only to reduce outdoor air pollution but various studies have reported the effects of some plants on the enhancement of indoor air quality by absorbing air-borne contaminants such as volatile organic compounds [28-33]. Changes in sensitive species of herbs and grasses occur much earlier than in shrub and tree populations. Generally, the degree of 'Crown die-back' and death of trees is directly related to the level of SO_2, NO_2 HF and HCl pollution of air. Tulsi (Ocimum sanctum) is sensitive to pollution and a minor change in pollution level is also been detected by this plant. Certain visual observations on the plant supported our prediction that Tulsi can be used as effective bioindicator for determining the increased level of nitrogen and sulphur status in atmosphere.

Pine tree barks and needles acts as indicators of different degrees of heavy metal pollution (Urban, Industrial, highway) concentrations e.g. lead (pb), zinc (Zn), nickel (Ni), cromium (Cr) e.g. Turkish red pine (Pinus brutia Ten.), Italian stone pine (Pinus Pinea L.), Australian pine (Pinus nigra) etc.

The responses of plants to pollutants may provide a simple way of monitoring air pollutants as well as providing the pollution abatement measures. Honey bee is an efficient pollution indicator that reacts quickly to various external factors likely to be used to determine environmental quality [34-43]. As a consequence of atmospheric nuclear testing, bee has been monitored as an indicator of radionuclide strontioum 90 in the environment [44]. But in cases of environmental pollution, existing problem in the environment is monitored by determining the traces in plant and animal origins along with honey bees and humans [45-46].

Birds as air and noise pollution indicators, indicates environmental contaminants which are widely distributed in the ecosystem, sensitive to toxins and high on the food chain [47-48]. Birds are easily getting short lived species after disturbance in their habitat and some air pollution activities may affect with physiological changes [49-50]. Bird's eggs are also good indicators of local source, since most bird in tropical and temperate regions spend many weeks on the breeding grounds before they lay eggs acquiring sufficient resources locally to produce the eggs. The wild birds use different sources of food and water in a relatively large area and thus the level of trace elements in bird's organs and feathers may reflect the levels of toxic elements in their entire home range. So, birds may give a better picture of hazards to man than measurements in the physical environment, plants or invertebrates [51]. Pigeons as an indicator species for monitoring air pollution and heavy metals like Zn, Pb causes DNA damage and traces of which is found in kidney, lung, liver and blood of pigeons e.g. Wild pigeons [52].

Bats are responsive to environment stressors and stable taxonomically, providing a wide range of services from pollination to pest control in the ecosystem [53-54]. A key character of appropriate pollution indicators like bat is to respond to alterations in an ecosystem, e.g. the ones in drought, agricultural practices, urbanization, light pollution and heavy metals [55-57].

2.2 SOIL POLLUTION INDICATORS:

Biological material (grass, leaves, bark, pine needles) in soil are analyzed to evaluate the possible uptake of contaminants and the relationship with the pollution sources. Fungi (Fusarium sp, Trichoderma sp, Aspergillus sp and Rhizoctonia sp) bacteria (Bacillus sp). Microbial counts responds to the presence of heavy metals in the soil and thus serve as microbial indicator species for metal pollution. Macro invertebrates indicators of pollution by heavy metals soil invertebrates respond to different environmental factors, including direct effect of heavy metals, suggesting confounding factors generating spurious relationships between the values of species as bio indicators and the pollution.

Algal species e.g. Chlorella vulgaris, C. pyrenoidosa, Hormidium flaccidum etc. Any change in the physio-chemical factors alters the composition of algal flora. Soil pollutants are minerals, nitrates, nitrites, sulfates, phosphates, anthropogenic pollutants. Soils are usually sampled for assessing their agricultural quality and evaluating contamination levels in polluted sites for heavy metals (pb, cd, Hg etc.), E.C, pH, texture etc.

Earthworm dead tissues increase the level of harmful chemicals in food chain and in this way soil health is indicated by these biological indicators with their particular behaviour in toxic soils. By means of 'earthworm acute toxicity test' possible risk of environmental pollutants on invertebrates of soil has been examined [58]. Both environment and human life are in danger, due to high levels of pesticides and heavy metals, which cause soil pollution, with the exposed organisms being the greatest invaders of such kind of complex effects is shown by earthworms [59-60].

2.3 WATER POLLUTION INDICATORS:

The aquatic environment with its water quality is considered the main factor controlling the state of health and disease in both man and animal. Nowadays, the increasing use of the waste chemical and agricultural drainage systems represents the most dangerous chemical pollution. The most important heavy metals from the point of view of water pollution are Zn, Cu, Pb, Cd, Hg, Ni and Cr. Some of these metals (e.g. Cu, Ni, Cr and Zn) are essential trace metals to living organisms, but become toxic at higher concentrations. Others, such as Pb and Cd have no known biological function but are toxic elements. In the attempt to define and measure the effects and presence of pollutants on aquatic system, biomarkers play an important role [61]. Various aquatic organisms occur in rivers, lakes, seas and marines potentially useful as biomarkers of metal pollutants, including fish, shellfish, oyster, mussels, clams, aquatic animals and aquatic plants and algae.

Microorganisms have a rapid rate of growth and react to even low levels of contaminants easily with indication of physicochemical and biological changes due to any change [62- 67]. Microorganisms are an important part of biomass and responsible for the majority of productivity and nutrient cycles of ecosystem [68].

Bacteria as indicator can be used in a variety of ways to detect environmental pollutants by changes in their habitat, morphological and chemical response toward activity. The presence of toxins in environment can be easily monitored either by changes in the digestion system of bacteria which is hindered or disturbed by the presence of toxins which may result in changes in bacterial species [69-75].

Zooplanktons are play an important role as pollution indicator and help to evaluate the level of water pollution. They are a vital part in indicating water quality, eutrophication and production of a freshwater body. Various species with their habitat of zooplankton is major indication of pollution. In order to determine the status of a freshwater body it is necessary to measure seasonal variations and presence of zooplanktons [76]. The potential of zooplankton as a bioindicator species is high on the grounds that their development and conveyance are subject to some abiotic (e.g. temperature, saltiness, stratification, and pollutants) and biotic parameters (e.g. limitation of food, predation, and competition) in ecosystem [77].

Marine Algae e.g. A. curicuatum, C. gracilis and P. capillacea are important pollution indicators of heavy metals (Co, Cr, Cu, Fe, Mn, Ni and Zn) in seas. Hydrophytes (Phragmites australis, Typha angustifolia, Potamogeton pectinatus, Ranunculus sphaerosphermus and Groenlandia densa) acts as bioindicators of iron and manganese pollutions in marshes and lakes. Green Algae (Enteromorpha intestinalis and Cladophora glomerata) acts as Bioindicators of Heavy Metal Pollution (manganese (Mn), copper (Cu), Zinc (Zn), Arsenic (As), cadmium (Cd) and lead (Pb) in stream.

Phytoplankton is shown major responses to alterations in environmental pollution conditions such as anthropogenic activity, industrial effluent contamination and other sources that introduced eutrophications in to waters bodies. Their presence or absence from the community indicates changes in physico-chemical environment of the water bodies [78]. For Example, Cynophyta, a type of phytoplankton, is one particularly powerful pollution indicator which is known to indicate rapid eutrophication of water bodies such as reservoirs, lakes, etc. via the creation of bloom formations [79]. Aquatic plants provide valuable information to predict the status of water environment, as they are

immobile and rapidly obtain equilibrium with their natural surrounding as caused by changes such as increases in the level of pollutants [80].

Somatic coliphages, bacterial indicators E. coli, total coliforms (TC) and faecal coliforms (FC) acts as bacterial indicators of bathing water. Coliforms The fecal streptococci have been used extensively as indicator bacteria in aquatic systems and this precedent has also been used to monitor the level of fecal contamination in soil. Any organism used in such a manner must represent a fecal source, be foreign to the soil environment, and possess characteristics which allow its differentiation from any other closely related organisms. Such criteria have been applied to certain fecal streptococcal biotypes as indicators of soil pollution, as Indicator of Faecal Pollution of water due to: they are abundant in faeces and they are generally found only in polluted waters.

Changes in water and habitat have been recorded from the use of feasible indicator acts as environmental logbooks which are the properties of freshwater mussels [81-86]. Alterations in habitat are promoted by humans; an ordered damming of creeks and rivers has had the most significant effect on freshwater mussels (Neves, 1993). The physical, chemical, and biological attributes of numerous rivers have changed from shallow flowing habitats to long linear pools drastically [87- 90]. Sedimentation is another process with harmful impacts on freshwater mussel communities.

Fishes are particularly vulnerable and heavily exposed to pollution because they cannot escape from the detrimental effects of aquatic pollutants [91-93]. All fish species are specific for their habitat so if high contamination of water easily shown by activities of fishes even the can die with major change in environment of water. Fish are located at the end of the aquatic food chain and may accumulate metals and pass them to human beings through food causing chronic or acute diseases [94-104]. Fish scales (Puntius sarana sarana (Hamilton), and Labeo rohita (Hamilton) due to Silicates, Nitrates, Cu, Fe, Mn, Pb, Zn, Ca etc causing damage of lepidonts on marginal circuli, Disruption of circuli and damaged lepidonts due to pollution of water.

Amphibians, particularly anurans which consist of frogs and toads, are increasingly used as pollution indicators of contaminant accumulation in environmental studies [105]. They also have permeable skin that can easily absorb toxic chemicals, making them a model organism for assessing the effects of environmental factors that may cause the declines of the amphibian population. These factors allow them to be used as pollution indicator organisms to follow changes in their habitats and in eco toxicological studies due to humans increasing demands on the environment [106].

Any pollution indicator may indicate harmful changes caused due to pollution into the ecosystem by variations in the populations, loss and changes in their activity. The change in response, presence and absence of any pollution indicator is indicating major changes in environment due to restricted contamination.

3. CONCLUSION:

In view of the existing state, environmental pollution has major impacts on the disturbance of biodiversity of ecosystem therefore indication of pollution in early stage is important. Alarm of changes in environment only possible by understand with all living pollution indicators. Although it is very difficult to make our environment free from pollution but it can be observed by indication of studied living organism before major harm. All environment pollution indicators are representative of nature to provide us knowledge of any change in our surrounding. Furthermore, focus on study of interferences that creates disturbance in the environment, causing pollution and leading to the loss of ecosystem services are necessary in future.

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