Chapter-I

INTRODUCTION

The spectacular progress of today’s world is surprising even though facing many global environmental problems to date. From very ancient time back, it was the tradition of man to interfere with many natural environmental situations. In due course of developments, it seems to found that remarkable impacts of man on its nature and now a day to meet the voracious needs of exploiting population, man interfacing the nature. It has been made by scientist and technologist to produce convenient goods and sophisticated services to the population but it causes the overall impacts in the form of global disaster.

The industrial effluents contaminating aquatic bodies contain a number of toxic metals, which in turn exercise their effect on fish and pose threat to aquatic life because of their persistence. The heavy metal including Aluminum and mercury has come to be regarded as the major factor in the loss of fishes showed by (R. Azhagu, 2014).

An unending industrialization, increasing population density and too much fast organization has increased severity of human population called explosion. In recent years the development of agriculture sectors, thermal plants, increasing vehicular traffic, sewage problem are indicating the good economic development on the one side and environmental damage so called pollution on the other side of the world studied by Ansari and Singh (1999).
Water pollution is a major problem related to the economic industrial growth of any country. The number of industries in India, during the last decade, has grown more than ten times and accordingly the problems related to environmental degradation have increased many folds. There is a need for sustainable development of economic growth and industries.

Some of the industries release their effluents either on the open land or in surrounding surface water bodies contaminating the soil, surface water and ultimately groundwater. Shrinivasa et al., (2005) assessed environmental risk and remediation of soil contaminated due to waste disposal from Tannery industries in Ranipet area. Romic and Romic (2003) showed heavy metal distribution in agricultural topsoil’s in urban area. (Krishna and Govil, 2004) showed heavy metal contamination of soil around Pali industrial area in Rajasthan. Among the all life constituents, the water have remarkable important for the life of plants and animals.

Due to modernization of the world with heavy industrialization causes too much domestic sewage and industrial influents which put our ecosystem into danger deeply explained by Osibanjio et al., (2011). Various chemicals showed their toxic effects on aquatic organisms and hence this pollution may cause the aquatic animals may reduce its number, their breeding efficiency which may also alter the natural behavioral patterns of the aquatic animals. The natural aquatic environment may alter with progress in agriculture including various pesticides, herbicides, fungicides and rodenticides etc. The industrialization may be responsible for aquatic influents including various chemicals like heavy metals such as mercury,
copper, aluminum, zinc etc. along with their byproducts (S. Imtiazuddin and Majid 2013, Govil et al., 1999).

The heavy metals are the intrinsic components of the earth’s crust and the first material available in the nature, the oxides of the different metals form the corrosion of products which are responsible for production of heavy metal stresses. The heavy metal exists in the variety of states in nature. The toxicity of metals depends on its nature and chemical form, whether it is ionic or un-oxidized or reduced state in combination with organic substances and other metals (Mali, 2002).

Among the environmental contaminants heavy metals have been recognized as a strong biological poison because of their persistent ability in nature and cumulative action same review studied by Chaitali (2013). Jyotsna and Manda (2015) assessed potential dietary toxicity of heavy metals in *Tilapia mossambica* in industrially polluted area. Shabnam and Badre (2015) showed the effect of heavy metals on fishes.

Hence by taking the fact into consideration the present investigation was undertaken to study the impact of important heavy metals found commonly throughout the world such as aluminum sulphate and mercury chloride on fresh water fish *Clarias batrachus*.

Heavy metals are discharged from textile industries into the marine and fresh water diversity (Turkmen et al., 2009). In the aquatic ecosystem fish is the top aquatic food chain component and may concentrate large amount of some metal from the water, further more fish is one of the most
sensitive indicators of trace metal pollution and rest potential of human consumption (Ashraj, 2005).

Today the human beings should turn their attention towards the pollution. The pollution study is necessary and mandatory for the wellbeing of human throughout the world but there is no universal toxicological design which might be used in studying highly diverse chemicals and various types of toxic materials found in the environment. The unending list of potential toxicant like heavy metals and other chemicals discharged as a effluents of industry. The excess use of pesticides and herbicides in the agricultural sectors so all are capable of reducing severe biochemical, histological, physiological and behavioral changes in the aquatic organism specially most of the crustaceans and fishes living in fresh water and marine habitats.

All the aquatic organisms favor optimum conditions for their survival in the environment. But due to man-made unwanted activities called pollution is responsible for changing the natural aquatic bio-system in the world. In this situation, tolerance is comparatively less, hence the organisms living in an environment, the tolerance capacity decides its natural survival. All aquatic animals are highly sensitive at reproductive phase of hatching and during metamorphosis.

Any alteration in natural habitat may cause this stress, affect the growth, maturation, reproduction and respiration rate of organisms ultimately may alter its natural physiological processes. The today’s modulated agricultural practices showed that the, pesticides, herbicides and excess use of fertilizers are the main reason of pollutants which finally rich
in the water bodies along with the stream of water. These agricultural practices can seriously cause the stress to the aquatic ecosystem.

The various types of chemicals like pesticides and some heavy metals such as carbonate, organochlorin, herbicides, organophosphates, zinc sulphate, mercury compound, aluminum sulphate, copper sulphate etc. are essential for agricultural practices and they acts as an important components for pest control. In fact their contribution causes increase level of crop yield but they may also produce number of side effects to animals and human beings. Thus, the heavy metals including pesticides pollution is dangerous to every aquatic fauna, animals, wild life fauna and human being by directly through its products (Omkar and Ramamurthy, 1985; M. Leela Shiva Parvathi 1999; Basha et al. 2001).

Heavy metals overload will be determined to the natural healing function of the body of organisms Kakulu et al., (1987). Heavy metals are trace metals that can be at least five times denser than water. They are hard to metabolize and bio-accumulative while they easily form the part of the food chain of humans and other animals.

Some heavy metals are highly toxic to every aquatic animals but their use in various sectors so easy release in the environment studied by (Fergusson, 1990). It is not necessary for living organisms but they can produce toxic concentration of the water (Khalid et al., 1978, Bryan, 1971). The effects of heavy metal contamination related to the environment and aquatic biota lead to serious consequences in nature studied ( Vosyliene and Jankaite, 2006; Farombi et al., 2007).
In the physiological range, these elements between deficiency, adequacy and toxicity are very narrow (Beijer and Jernelove, 1986). At a large scale the effects of trace elements on the ecosystem is very detrimental (Watson et al., 1976).

Aquatic environment is the major and main target of pollution. Man has discovered the water used to dilute and transport industrial effluents from one place to other place. Some heavy metals are essential but some of them are like mercury, cadmium, lead is highly hazardous to the aquatic ecosystem (Mali, 2002).

In developing countries growing the human population further aggravated the problem of pollution. Industrialization and urbanization creates the problems of aquatic eco-system (Waghmode et al., 2008). Natural waste are contaminated due to man-made excess use of chemicals has caused serious problem to the management of water quality and pose a threat to the aquatic eco-system. Industrial effluent causes aquatic pollution. It contains vast toxic substances which include heavy metals and alternately it cause changes in the quality of water and hazardous to the food chain of environment.

During the process of metabolism of aquatic organism, heavy metals may interrere the processes. Physiological and biochemical alteration occurs in the animal after the accumulation of heavy metals may cause mortality of animals. Toxicity of heavy metals cause death of organisms or it shows effect on development, feeding, activity, reproduction and general physiology (Mali, 2002).
Heavy metal in which Hg have so far unknown roles in living organisms and are toxic even at very low concentrations (Nies, 1999). Since many heavy metals can be very toxic and thus may threaten the health of organisms, studies have been conducted to investigate heavy metal level in environmental samples as well as heavy metal accumulation in and effects on organisms and factors affecting heavy metal accumulation by various organisms. Heavy metals can be presents in various particulate forms as colloids or aggregates, bound into particles, precipitated as metal coating on particles.

The physical and chemical forms of heavy metals in the fresh water ecosystem are governed by environmental variables such as temperature, salinity, pH, biological activities and metal properties (Lobban and Harrison, 1994). The bio-accumulation of toxicants, such as heavy metal by living organisms is often a good integrative indicator of exposure and has been extensively used to assess contamination levels of heavy metals in polluted ecosystems (Phillips and Rainbow, 1994).

Fishes are the highly sensitive to any lite change in water quality of it habitat and the freshwater *Clarias batrachus* is a leading catfish in terms having the capability for terrestrial migration to nearby water bodies. It has the additional capacity to undergo aestivation in order to survive short spells of water scarcity (Ahmed et al., 2012).

The species is more adapted to life in oxygen depleted water condition. It is used for convalescent of the patients and malnourished persons because of its high nutritional status studied by (Debnath, 2011). It
has the unique capacity to successfully survive under hyper ammonia stress, which it has to face in its natural habitats at certain season of the year studied by (Karbassi et.al., 2006). *Clarias batrachus* has excellent nutritional profile due to its high protein, low fat and high iron content value. Its feeds are aquatic organisms such as small fishes, prawns and other aquatic insects. They can eat nonstop when food is available, but when food is scarce they can survive for month without eating.

The fish is remarkable because it can survive with food and water for some reasonable length of duration. It also has the ability to sting during manhandled or captured, which can be quite painful. The defense mechanism is hidden in the pectoral fins observed by (Scheng, 2010). *Clarias batrachus* is one of the notable freshwater fish. All the remarkable attributes of this species highlighted above, with proper focus, could be turn into economic and social advantages. Dahiya et al. (2012) observed that positive response in the values of the hematological parameters of *Clarias batrachus*.

Toxicology can be defined as a branch of science which deals with the study of adverse and harmful effects of chemical agents on any biological system. In the present scenario of fresh water aquatic biota in dist Nanded, Maharashtra having nice biodiversity of fishes. Out of these, *Clarias batrachus* is not too much considered for the toxicity study in this area.

Hence the present research work, *Clarias batrachus* is used as indicator organism from fresh water biota. Hence, it is a good indicator to study the toxicity of heavy metals. The toxicity of a metal depends on the
capacity of a metal to affect adversely any biological activity. Toxic metals change the biological structures and systems into inflexible and irreversible confirmation leading to deformity in the body or finally death.

Almost all metals are toxic at higher concentrations and same are lethal even at very low concentrations. The heavy metals within limits are essential for aquatic organisms, plants as well as humans to survive and function. Tolerance is defined as ability to endure the continued and for increasing administration of toxicant. It is also the capacity of an organism to exhibit less response to a test does of a chemical that it did previously to the same dose.

In 1927 Traven coined the term LD which is defined as the minimum doses of a toxicon or the dose at which all test animal die. The minimum lethal does (MLD) can be defined as the dose that will kill at least one animal in the test population. The doses are expressed as milligrams of metal or salt per kilogram body weight of the animal. LC$_{50}$ is the dose concentration of toxicant at which 50% animals die after it exposure.

The heavy metals are the main source of water pollution. Most of the heavy metals are studied but aluminium and mercury has given less attention in the Marathwada region, hence the present investigation, the aluminium and mercury has been selected. The details about these two heavy metals as given below:-
Aluminum (Al):-

Aluminum occurs as bauxite, spinal, muscovites and orthoclase. The earth’s crust contains about 8% aluminum in decomposed rock fragments. A man’s body contains about 6 mg aluminum, 35% of which is in the skeleton and about 20% in lungs. Aluminum is not an important element for mammals.

Many of aluminum compounds undergo hydrolysis and form colloidal aluminum hydroxide or colloidal aluminum phosphate and are removed from blood by phagocytosis; however a small protein of aluminum icons is transported into brain.

Aluminum compounds in very high doses they create gastro-intestinal irritation and shaver’s disease in lungs. The contamination of fresh water with a wide range of pollutions has become a matter of concern over the last few decades. The natural aquatic systems may extensively be contaminated with heavy metals released from domestic, industrial and other man-made activities. Heavy metal contamination may have devastating effects on the recipient environment and a diversity of aquatic organisms.

The heavy metals are inheriting environmental contaminants with the capability of causing human health problems if present in human health problems if present in excess in the food one taken every day. There may be no visible sign of an unacceptable level of residue, especially for toxic elements like Cd, Pb, Hg etc. at higher concentration they may poison their host. Human activity is continuously increasing the levels of trace elements circulating in the food stuffs. Fish samples are considered as one of the most
important indicative factors in fresh water systems for the evaluation of trace metal pollution potential.

The forceful intensity to study the heavy metal pollution in marine water as well as fresh water has been started with the tragedy of Itai-itai and Minimata in Japan. This event has resulted in an awareness of the problems of bioaccumulation of heavy metal including mercury and aluminum by aquatic organisms.

It urged extensive necessary research in examination of levels of metals in aquatic animals and concerns other foods to human being. As depends on the intensity of increasing industrialization, the past research on the effects of heavy metals and other pollutants on aquatic organisms is too much scanty hence it could might a concluded that still the research on same line has to be done. Most of such a heavy metal compounds should be banned and required strict control over its utilization as well as dumping the waste material from different sources throughout the world.

As compared to most of the terrestrial animals the aquatic organisms are highly sensitive to the heavy metals. The quickly respond to any alteration in the water the detail survey of concern literature should that relatively few atoms have been made of limited aspects of heavy metal toxicity on cat fishes.

There are some reports available with respect to metallic treatment on cat fishes such as mercury chloride. (Elvan et al., 2012, M. Lambert, et al. 1997, Rajaram et al,2008, Singare et al., 2011)

But specially study on impacts of these heavy metals on Clarias batrachus; receive less attention with scanty reports. This fish was selected because of its high commercial value, it is rough and tough, medicinal value, nutritional superiority, easy availability and adaptability to laboratory conditions.

So present work is undertaken on effect of two heavy metals includes aluminum sulphate and mercury chloride on freshwater catfish Clarias batrachus from Nanded region.

The industrial effluents contaminating aquatic bodies contain a number of toxic metals, which in turn exercise their effects on fish and pose threat to aquatic life because of their persistence. Aluminum has come to regarded as the major factor in the loss of fish.

**Aluminum Sulphate:-**

Aluminum sulphate is important to protect and awareness from mercury exposure. Aluminum sulphate is also named as alum. Aluminum is a soft and light weight metal. It is an abundant element in earth crust; it is third most prevalent element of earth’s crust and is not found in the free state. The human exposed to aluminum because adverse elites and specific segments of the population are at particular risk.
The study is essential for awareness of the basic steps of the risk assessment, the assessment process was first described in 1983 (US NRC, 1983) used a review of human health concern from aluminum exposure. The assessment of aluminum exposure includes four steps–hazard identification, dose response relationship, and assessment exposure and risk character station.

Aluminum is one of the abundant metals (7% of the earth crust) and they spread into the aquatic environment. It is released into the environment by natural processes and from anthropogenic source. It is having melting point 649.8°C aluminum is used for everything from medications to door frames and car bodies.

**Chemical name:-**

Synonyms : - Aluminum salt, Alum. Cake alum, Filter alum, Aluminum Sequisulphate, Aluminum trisulphate.

IUPAC Name : - Aluminum sulfate

Molecular weight : - 599.75(342.14 Anhydrous)

Molecular formula : - Al₂ (so₄)₃

Odor : - Odorless

Physical state : - Crystalline, granules or powder

Appearance : - Lustrous white to grayish white solid.

pH : - 3.0- 4.0 at 25°C

Melting point : - Decomp at 770°C

Boiling point : - 1600°C (anhydrous)

Solubility : - (H₂O) -87.5g /100ml at 20°C
Structural formula:-

\[
\left[ \text{Al}^{3+} \right]_2 \left[ \begin{array}{c} \text{0} \\ \text{S} \text{O}^2- \\ \text{0} \end{array} \right]_3
\]

**Fig: 1.1- Structure of Aluminum sulphate**

**Mode of Action**

Aluminum sulfate is used in purification of water and as a mordant in dying and printing textile. Aluminum sulphate dissolves in a large amount of neutral or slightly alkaline in water. Aluminum sulphate increases a gelatinous precipitate of aluminum hydroxide (Al (OH)₃.) In dying and printing cloth, the gelatinous precipitate helps the dye adhere to the clothing fiber. Aluminum sulphate is used for sometimes to reduce the pH of garden soil.

Aluminum released to the aquatic environment by the natural process and from various anthropogenic sources. The modern technological age could not have occurred without the availability of aluminum. Aquatic animals particularly fishes received the aluminum metal through the intestinal tract, gills, skins and accumulate in the body tissues and cause the various symptoms like stress and gill hyperplasia except that effect on coloration and activity were more rapid for dissolved aluminum.

The rate of mortality suggested different modes of toxic action for dissolved aluminum. The effect of chronic toxicity appeared related to the
digestive system or an impairment of the nervous system controlling the function of the system.

The different modes of action and theirs symptoms includes inhalation of aluminum causes cough, shortness of breath, sore throat, skin redness and pain, eyes corrosive deep burns. Ingestion—abdominal pain, burning sensation, nausea and vomiting. The old sixty six years caucasian man developed and aggressive form of early disease Alzheimer’s after eight years of occupational exposure to the aluminum dust, which scientist includes “suggests a prominent role for the all factory system and lungs in the accumulation of aluminum in the brain. Aluminum exposure has been implicated in Alzheimer’s and other neurological disease. In first case study to show direct link between Alzheimer’s and aluminum toxicity.

Aluminum sulfate can cause severe irritation and inflammation to the eyes and skin. Contact may cause permanent damage. Concentrated solutions are corrosive to the eyes, skin and gastrointestinal tract. When heated to decomposition, aluminum sulfate may emit toxic and corrosive fumes of sulfur dioxide and sulphate trioxide some sources of aluminum are use of steel utensils on aluminum cook ware can cause additional toxicity by scraping aluminum into food. Aluminum cookware could be a cause of headache, colitis and indigestion the beer and cola drink per day can lead to aluminum toxicity, most antacids contain significant amount of aluminum hydroxide.

The physiological mechanism of aluminum toxicity have been investigated mostly for fish (specially catfish *Clarias batrachus*) and there are fewer investigations on other organisms. Disruption of respiratory gas
exchange across the gill and impairment of ion regulation has been observed. The other sub-lethal concentration of aluminum showed reduced growth histopathology and change in behavior and aberration in skin coloration. In present investigation, the impacts of heavy metals such as mercuric chloride and aluminum sulphate studied on freshwater fish *Clarias batrachus*.

In present investigation, the freshwater air breathing fish, *Clarias batrachus* has been selected to study the impacts of heavy metals aluminum sulphate and mercury chloride. The fish *Clarias batrachus* has been selected because it is highly sensitive to alteration in aquatic medium hence the fish may act as the biological indicator for aquatic biota.

**Mercury (Hg):**

Mercury is a high heavy metal occurs at native metal mixed with its ores. The human body contains about 13 mg Hg, about 70% of which is present in fat and muscle tissue. Hg containing insecticides and fungicides cause Hg toxicities. The retention of absorbed Hg in soft tissues is high and follows the distribution: Kidney > liver > intestinal and colon Waals > brain > heart > lung > respiratory mucosa > muscles> skin. The kidney retains maximum concentration of Hg. In human body Hg was found in brain, liver and in serum proteins. Tissue retention is greater for CH$_2$Hg$^+$ than of Hg$^{2+}$ salts. The toxic action is due to crowding of Hg$^{2+}$ ions around the immediately available thiel groups of proteins and delay in distribution of these ions among rest of thiel group throughout body.
Mercury toxicity is a worldwide problem as mercury and its salts are industrial health hazards. Hg is found in water due to disposal of industrial mercury waste. Excess of mercury (more than 100mg) may cause headache, abdominal pain, diarrhea, hemolysis, digital and tremors. Hg vapors causes acute tightness and pain in chest causing great difficulty in breathing. Mercury acute tightness and pain in chest causing great difficulty in breathing. Hg compounds affect central nervous system.

According to (Jyotsna and Mhatre, 2015, Ashok kumar, 2015) microorganisms convert mercury into methyl mercury salt (CH$_3$HgCl) and dimethyl mercury which escapes into through bacteria and ultraviolet light toxic dimethyl (alkyl mercury) also changes into free toxic elemental mercury.

![Chemical reaction diagram]

As CH$_3$Hg$^+$ has covalent bonding hence it is more stable than ionic Hg-Br bond. CH$_3$Hg$^+$ can exist greed only in small concentrations.

This methyl mercury is in fact very toxic and can enter into cellular membrane. Blood serum proteins form –S-Hg-CH$_3$ complex and are
responsible for killing of fishes in rivers and oceans.

From industries, methyl mercury settles as sediment into the water and from where fish trap various mercury salts and dialkyl mercury in their tissues. In fact organic mercury compounds of low concentrations are non-toxic to men-the occurrence of neuro toxic Minamata disease is people living near Minamata Bay in Japan was caused by eating mercury contaminated fish. The mercury contamination was observed due to industrial wasters of vinyl chloride factories using elemental mercury as a catalyst.

**Mercury Chloride:**

The heavy metal especially mercury have become prominent pollution even in trace amount .Mercuric compound are one of the more toxic metals among the heavy metal .Mercury and its compounds are discharged in to the aquatic environment from various substances, viz plastics, chloralkali, paper mill fungicide, steel, cement and melting of metal is a highly toxic, non-essential persistent, immutable and non-biodegradable metal that undergoes many changes during transfer through different trophic levels of the food chain. Jayanthi and Selvakumar (2011) showed the effect of mercury chloride on freshwater fish.

The Sanskrit word Rasavatam means the way of mercury (Cox, 1997). Mercury chloride is a chemical compound of mercury and chlorine with the formula HgCl₂. Mercuric chloride is not a salt but a linear triatomic molecular, hence its tendency to sublime each mercury atom is bound by
two close chlorine lig and with Hg-Cl distance of 2.38 and is a cumulative highly toxic.

Properties: -It is a compound of mercury and chlorine

- It is a white crystalline solid.
- It is having a molecular formula Hgcl₂
- Molar mass of mercury chloride is 271-52/mole
- It is odourless compound
- It having the density 5.43g/cm³
- Melting point is 276 °C
- Boiling point is 304°C
- It is highly toxic

![Structure of Mercury chloride](image)

**Fig: 1.2 - Structure of Mercury chloride**

The water may contaminated by another toxic metal mercuric chloride. The inorganic mercury compounds are easily and rapidly absorbed by the most of the aquatic animals including crustaceans, molluscs and fishes through gills, digestive tracts and skin. The fishes and other aquatic animals showed many pathological changes along with consequent inhibition of metabolic processes, decline in fertility and survival, many
behavioral changes, hematological alterations and may disturb the natural food chain of aquatic animals, by considering all above impacts of heavy metal mercuric chloride on aquatic biota. It is highly necessary to study the toxicity of mercuric chloride on fish.

**Mode of Action:-**

It is one of the heavy metal used in various industries. Mercury is highly toxic compound to aquatic organisms and human beings. The vital organs like brain, liver, heart and kidney are most sensitive. Many investigators were reported mercury toxicity with respect to enzymological reproduction and physiological aspects in fishes.

Mercury chloride causes gonadal, adrenal and neurotoxicity. The organ mercury compound are rapidly absorbed by fishes from water through gills, digestive tract and skin, the water is contaminated by Hgcl2, the fishes suffer pathological changes with consequent inhibition of metabolic processes, decline in fertility and survival, hematological alterations behavioral changes and disturb the natural life of fishes. Hence this study is necessary to determine the toxicological study of mercury chloride to fresh water.

This study also demonstrated to regulate the discharge of mercury chloride from the industries and domestic effluents into aquatic systems. There is a necessity for further research on this topic so as to establish for freshwater fish such as *Clarias batrachus* and other fishes for human consumption throughout the India particularly Nanded region in Marathwada.
The human exposure by mercury in a short time showed high level toxic effects. A case study has shown effects such as sleep disturbance with low concentration. Acute exposure cause cough, chest pain, impairment of pulmonary function. After long term exposure, urinary excretion increases. Low level exposure cause loss of memory, irritability depression and vivid dreams (WHO, 1976). Mercury chloride distributes to the all tissue level with in 24 hrs. except in the brain (Hursh et al., 1976).

Mercury chloride action is similar an aquatic animals and humans. Mercury chloride enters an oxidation – reduction cycle starts (ATSDR, 1999). The primary target action of mercury chloride on the nervous system, developing foetus and kidney. Other body systems area also affected such as digestive system, cardio-vascular system, respiratory system, reproductive system, immune system and hematological systems. (USEPA, 1997)

The concentration of mercury in human beings and other mammals have been determined in body tissue, urine, hair, breast milk and blood. Mercuric chloride exposure and give its toxic effect to the kidney, intestine, stomach and cause increased blood pressure (Audicana et al, 2001). Mercuric chloride exposure Khan et al., (2004) during pregnancy period and its impact on neurological and cognitive development of children.

The action of mercury and mercury compound is the best example of Minamata disease in Japan.
Minamata Diseases:-

This disease is caused by mercury poisoning. It is characterized by crippling and death minamata disease is neurological syndromes caused by sever poisoning of mercury. This disease appeared in a coastal town, Minamata in Japan.

The primary reason for this disease was a plastic industry which was started on the sea coastal area of Japan in 1905. Mercury was disposed into the sea water from factory. Mercury accumulated in the body of marine animals. There were thousands of marine fished died at costal region later birds, cats, dogs and man’s receive fishes and other marine animals. The accumulation of mercury leads to crippling and death. There initial symptoms of Minamata disease includes – numbness of limbs, tongue and lips, impairment of motor control deafness and blurring of vision, finally the effects of mercury destroy to the brain.

Metallic mercury used in glass thermometers silver dental filling and button batteries, mercury salts used in skin creams of ointments, it also used in mercury industries. They dispose and pass through food chain and build up in fish and other aquatic animals. The nervous system is sensitive to mercury, exposure to high levels on damage to the brain and kidneys pregnant women on pass mercury in their bodies to baby.
Test Fish:-

Air breathing freshwater fish *Clarias batrachus* was selected for the present study. Fishes are more sensitive aquatic animals hence it helps for the toxicological study of heavy metals.

Selection of Animal:-

For present investigation, the freshwater catfish *Clarias batrachus* has been selected because of its high protein and tasty food value. It is rough and tough species easily available and adaptability to the laboratory conditions. The animals were collected through fisherman from Nanded region, Maharashtra, the systemic position of *Clarias batrachus* is given below:

**Classification of Fish:-**

Kingdom - Animalia
Phylum - Chordata
Subphylum - Vertebrata
Super class - Osteichthyes
Class - Actinopterygii
Subclass - Neopterygii
Intra class - Teleostei
Super order - Ostariophysi
Order - Siluriformes
Family - Claridae
Genus - Clarias
Species - *Clarias batrachus*
Identification of fish with help of day volume (Day 1958):

D-62-76, P-8, V-6, A-H5-58, C-15-17 length of head to end of gill covers—
5Eyes – diameter 2-2.5, the width of the intro-orbital space equals half the
length of head.

![Fish Image](image)

**Fig 1.3- Clarias batrachus**

**Morphological characters :-**

* The head is flat bony and broad, terminal.
* Mouth with four pairs of burbles.
* Colour of the body green to brownish superiorly becoming lighter
  beneath.
* Body is flattened and trunk and tail region laterally compressed.
* Gills opening are wide and they are located at lateral position.
* A single large dorsal fin from head region up to the tail.
* Clarias species are recognized long-based dorsal and anal fins look like as
  eel-like appearance.
Habit and habitat:-

*Clarias batrachus* is one of the most important tasty and high protein value fish in Nanded region. Its habitat is fresh water to brackish water. It lives long – after its removal from its native element being amphibious. As a food it is highly nourishing. It is locally called (magur) *Clarias batrachus* derived from two words (Claros –lively). It is reference to the ability of the fish to live for a long time out of water.

It is distributed throughout the India. *Clarias batrachus* is a rough and tough fish so they can live out of water for a long time it is occurred in a muddy place and turbid water area. *Clarias batrachus* occur in muddy stagnant water, muddy to running waters. *Clarias batrachus* is a freshwater, primarily in swamps, slow steam, ponds, lakes with muddy bottoms and vegetation, able to live in deoxygenated water and travel limited distance overload.

**Economic Importance of fish:-**

1) Many of the species are of great economic importance in fisheries and fish culture.

2) Fish has a great economic importance, main food in various regions of India and good commercial value.

3) *Clarias batrachus* used as a medicinal value.

4) *Clarias batrachus* as is a tasty, food fish and high protein value.

5) It is used for the treatment of asthma.