

# **CHAPTER I**

## **INTRODUCTION**

### **1.1 Background**

The issue of water quality standard in the environmental is an important issue for everyone. Water quality in the bodies of water such as lakes, rivers and oceans has direct impact to human. Water quality standards vary widely because of differing environmental conditions and ecosystems, and the intended use rights. Toxic substances and high populations of certain microorganisms can pose a health risk for non-drinking purposes such as irrigation, swimming, fishing, and industrial uses. These conditions may also affect the wildlife that uses water for drinking or home. Modern laws are put in place determine the quality of public water to protect fisheries and recreational use to maintain a certain quality standards. The use of water in lakes, rivers and to a large extent, ponds, and streams is determined by water quality. There is a need for water quality, especially for the supply of potable water. In many parts of world the introduction of pollutants resulting from human activity has degraded water quality, making it less useful to use (Hill, K.M. 2004).

Water is a natural source that is renewable and can be recycled by nature. Our earth contains about 97% of salt water and only 3% of fresh water. However, human can only use as little as 0.003% of fresh water in rivers, lakes and groundwater (Tyler, 1993). Thus fresh water is a very valuable thing that we need to take good care of through good water quality management to control pollution caused by human activity so that the water is not degraded to the point that it is no longer suitable for its intended uses. At present, human activities have caused a lot of adverse effects on water quality especially on rivers. The contamination of water in turn affects human health as well as the plants and animals. Consumption of polluted water in rivers and lakes was a serious problem in East Asian countries (Hallock., 2002).

### **1.2 Water Pollution**

Water pollution is any contamination of water with chemicals or other foreign substances that are detrimental to human, plant, or animal health. These pollutants include fertilizers and pesticides from agricultural runoff; sewage and food processing waste; lead, mercury, and other heavy metals; chemical wastes from industrial discharges; and chemical contamination from hazardous waste sites (NIEHS).

Water pollution can also be described as an undesirable change in the water condition that decreases the water quality. Once the water quality decreases and becomes low from the acceptable level for a particular use, the water will be classified as polluted. Pollution occurs when pollutants enter the water body. Pollutants are any substances that are introduced into water body by human activities or naturally occurring, Prabhakar, V.K. (2000).

Also stated is that the source of water pollution can come from natural run off, dissolved chemicals in water that permeate through soil as well as from human activities such as agriculture, mining, construction, industry, homes and businesses. Water pollution caused by human activities can be classified into pollution caused by industry, homes and businesses. Actually there are many sources where pollutants can enter the water body. In general the sources of pollutions are divided into two categories known as point sources and non point sources.

### **1.2.1 Point Sources**

Point sources pollution is the pollution source that comes from an identified and specific source that goes into water body (Jones, G. 2003). The example of a point source includes the discharge pipe from a factory. Point sources are easy to control and monitor as compared to non point sources. However, the effect of point source to the water quality is more rapid compared to the pollution caused by nonpoint sources.

### **1.2.2 Non-Point Sources**

Non-point source pollution is defined as the introduction of impurities into a surface-water body from a source that is not specific and hard to identify (Jones, G. 2003). It is hard to isolate and control the non-point sources. The examples of non-point

sources are automobile emission, road dirt, and runoff from parking lots as well as runoff and leachate from agricultural fields. In this study the effect of fertilizer used in agriculture on water quality will be discussed. The use of fertilizer in agriculture is categorized as non-point source.

The vast majority of surface water on the planet is neither potable nor toxic. This remains true even if sea water in the oceans (which is too salty to drink) is not counted. Another general perception of water quality is that of a simple property that tells whether water is polluted or not. In fact, water quality is a very complex subject, in part because water is a complex medium intrinsically tied to the ecology of the Earth. Industrial pollution is a major cause of water pollution, as well as runoff from agricultural areas, urban storm water runoff and discharge of treated and untreated sewage (especially in developing countries). Contaminants that may be in untreated water include microorganisms such as viruses and bacteria; inorganic contaminants such as salts and metals; pesticides and herbicides; organic chemical contaminants from industrial processes and petroleum use; and radioactive contaminants. Water quality depends on the local geology and ecosystem, as well as human uses such as sewage dispersion and industrial pollution, (Mohammed Abushammala. 2008.)

Water is in the fact the most important elements of life on Earth for humans to live, but it may also be the cause of life-threatening diseases when it becomes contaminated. Water pollution curve has already taken the rising trend and appeared to threaten the availability of this essential ingredient for life. There are a number of reasons and sources of water pollution, naturally and artificially. Pollution can occur from the erosion of the surrounding areas in areas of water as well as the expansion of aquatic plants floating on the surface of water. Human activities such as agriculture and industry have also caused major pollution which had a huge impact on the lives of organisms that consume and live in fresh water bodies such as rivers, lakes. This polluted water unfortunately is used also by human for drinking; cooking and irrigation etc. water quality is thus an important issue. We need to pay attention and understand each and every possible cause of water pollution so that we can correct the problem. One example of crisis in this water issue is found in Rawapening Lake where a mass of water hyacinth

plants dominate a large part of the lake's surface area. A possible cause of the phenomenon is the wide spread use of chemical fertilizers in the surrounding areas of the lake. That is why this research is studying the impacts of fertilizers on water quality of the lake.

In the ecosystem of Rawapening Lake water hyacinth is one of the biotic components that play a major role in the lake. It produces oxygen for the lake through the process of photosynthesis. Water hyacinth also becomes food for various types of organisms that live in Rawapening Lake, such as insects, fish, snails, etc. its presence in the Rawapening Lake coastal waters became a refuge for various types of aquatic animals such as fish, water insects, animals and even rats, frogs. The area under the water hyacinth is a comfortable place for fish species in the Lake. As an autotrophy organism, the various organs of water hyacinth grow beneath water and accumulate at the bottom. After the plants die they partially decompose and release nutrients in various aquatic environments that can be utilized again for autotrophy organisms in these waters. Parts that have not decomposed then form an organic layer in the bottom of the waters and form the peat layer (Sucahyo, et al, 2002). For the society around Rawapening Lake the presence of water hyacinth has been used as green manure for crop cultivation so as to enrich the organic matter content in the surrounding area. It can also be used as raw material for making paper and produce bio gas.

However, the growth of water hyacinth has continued to increase disproportionately, as can be seen from the lake's surface area covered by the mass of water hyacinth. In the year 2002 it was estimated that the mass of water hyacinth that covered the area of the surface waters around 20-30% and was expected to continue to rise in the subsequent years to come. This water hyacinth proliferation has made the plant becoming the enemy of many people as it created many negative effects to the environments and people who live around the lake. Efforts now are being taken to control the growth of the plant. The presence of water hyacinth in Rawapening Lake differs from one part of the lake to another because this lake gets its water from some different upstream catchment areas which have water content of different quality caused by the activities in their respective upstream regions. The vast presence of water hyacinth is one

of the phenomena resulted from these activities in the upstream areas, where the use of pesticides and fertilizers by farmers in their paddy fields may stimulate faster growth of water hyacinth. This study wants to know and measure the impacts that fertilizers have on water quality, especially in connection with the growth of aquatic plants which have covered a large part of lake area, causing environmental problems

### **1.2.3 Chemical fertilizers and their impacts on the environment**

Chemical fertilizer is among the most important factors that helped increase and develop agricultural production. As indicated by global statistics, 30% of world agricultural production increase has been achieved thanks to the use of chemical fertilizers. On the other hand, the intensive use of fertilizers has worked on leaving many traces and negative elements to the environment (water, soil and air). Chemical fertilizers work when added to the soil. The accumulations of various chemical elements however, may lead to numerous environmental problems such as contamination of groundwater used for drinking and irrigation for crops. The degree of negative impacts brought by different kinds of chemical fertilizers on the environment is varied depending on their contents. The nitrogen fertilizer and phosphate fertilizers however, are thought to have the largest impact on the environment. This has prompted research centers and specialized scientists to study these negative effects and severity on the environment and to find ways to reduce them. Nitrogen fertilizer is the most common types of fertilizer, with a share of 50% of the total fertilizers used worldwide. Because of its vital importance and their positive effects on various plants, it has been used excessively, leading to high nitrate levels on the ground. Rain and irrigation will then bring these unstable ions into water bodies and groundwater. Several studies including the one recently published have confirmed that the high concentration of nitrate can cause diseases such as stomach and intestines cancer. These phenomena occur mostly in rural agricultural areas. Also detected are cases of nitrate poisoning in cows that graze on grass irrigated with water containing large amounts of nitrates. The reduction of nitrate into nitrite by microorganisms when the animals ruminated led to the formation of Arsenate Nitrate which caused a similar effect for the disease Almitocalobinmia. The contents of nitrogen fertilizer, particularly the ammonium compounds lead to a reduction in rates of

magnesium in plant tissue which causes Alhipmagnnisya (Grass Tetany) in cattle that graze on it due to lack of magnesium in the blood. It is thus necessary to choose a fertilizer with low mineral salinization indicator, especially in saline soils. The presence of excessive nitrate in the soil compared to other elements such as phosphorus and potassium also works to prolong the period of vegetative growth at the plant that leads to reduced flowering and delayed maturity. It makes the plant to sag and become more vulnerable to diseases.

Increasing concentrations of nitrate and phosphorus in lake water in high proportion leads to a phenomenon of Atrophic Caution, or an increase of the growth of parasites and aquatic plants including algae. The growth of these organisms leads to the depletion of oxygen from the water. This in turn encourages the growth of anaerobic organisms which generate outputs such as methane and ethylene. These compounds are toxic to organisms. The increase in the concentration of nitrates also encourages the growth of bushes, especially those of the reeds and papyrus which can block the flow of water. This environmental problem will then cause financial losses as the growth of aquatic plants and algae will have negative effects on the fisheries sector. More to it clearing these bushes to unblock the flow of water certainly requires energy and money.

Phosphorus is an immobile in the soil system, unlike nitrogen, thus the possibility of infiltration of groundwater is low. It is however, degrade very slowly and stay in the soil for a long time, so the possibility of a transfer into surface water through erosion processes of the soil and move along with runoff water current is a possible and significant threat to water quality. Phosphorus is the limiting factor that works and accelerates the process of eutrophication of surface waters and the degradation of the marine life there. The increasing levels of phosphorus in the soil will disrupt the balance of nutrients in the soil and reduce the productivity. There is also fear of accumulation of heavy metals as these elements are present in the chemical fertilizers component. The intensive and continuous use of such fertilizers in agriculture increases the possibility of accumulation of cadmium in the soil and the possibility also of absorption by the plants consumed by human or animal which constitutes damage to human health and animals.

Chemical fertilizers also have residual effects as they increase the salinity of the soil. This in turn reduces the plant's ability to absorb water. Also, high concentrations of fertilizer in the soil inhibit growth as it brings with it accumulation of salts in the soil, which hampers the growth of microorganisms in the soil. As an example, the effectiveness of the enzyme Aliuriz produced by the bacteria is less clear in soil with high salinity. This leads to a decrease in the amount of inorganic nitrogen available for plant.

### **1.3 Water hyacinth (*Eichhornia Crassipes*)**

Water hyacinth is an aquatic plant which can live and reproduce floating freely on the surface of fresh waters or can be anchored in mud. Plant size ranges from a few inches to a metre in height. Its rate of proliferation under certain circumstances is extremely rapid and it can spread to cause infestations over large areas of water causing a variety of problems. It grows in mats up to 2 metres thick which can reduce light and oxygen, change water chemistry, affect flora and fauna and cause significant increase in water loss due to evapotranspiration. It also causes practical problems for marine transportation, fishing and at intakes for hydro power and irrigation schemes. It is now considered a serious threat to biodiversity.

The plant originated in the Amazon Basin and was introduced into many parts of the world as an ornamental garden pond plant due to its beauty. It has proliferated in many areas and can now be found on all continents apart from Europe. It is particularly suited to tropical and sub-tropical climates and has become a problem plant in areas of the southern USA, South America, East, West and Southern Africa, South and South East Asia and Australia. Its spread throughout the world has taken place over the last 100 years or so, although the actual course of its spread is poorly documented. In the last 10 years the rapid spread of the plant in many parts of Africa has led to great concern.

### **1.4 The ecological aging process of a lake**

The ecological aging process of a lake is the natural process that fills the lake, over geologic time, with sediments, silt and organic sediments. These materials can be in the lake tributary streams or come from materials produced in the lake itself. Natural aging of the lake takes place over hundreds of years. However, human activities can

greatly accelerate the process. Runoffs from urban and agricultural areas may carry liquid wastes, fertilizers and pesticides that come as by-products of human activity. These materials may then be discharged into the lake and thus lead to the acceleration in the aging process of the lake or the river. Most human-oriented land uses, including agriculture, residential development, and trade contribute to this aging process. Thus it is also called cultural aging process.

One example of cultural aging is the use of chemical fertilizers with rich phosphate content in agriculture. Some of the phosphate will be released into water bodies and ended up in the lake because phosphate content in the fertilizers cannot be absorbed completely by the plant. Increasing amounts of phosphorus accumulated in the lake can cause huge increases in aquatic plants and algae, which in turn will contribute to the huge quantities of substances that degrade and die in the lake.

### **1-5 Problem of study**

Rawapening Lake supports many activities and the life of people and animals, including fish and birds. It is however, considered as one of the lakes under serious threat in the area of Semarang, due to the problems it has with the fast growing water hyacinth. The study will try to know if there is any concentration of phosphates and nitrates in the water and measure the relation between the rapid growth of the water hyacinth and the amount of fertilizers used by the farmers in the upstream area of the lake.

### **1.6 Research question**

How high is the concentration level of phosphate and nitrate in Rawa Pening Lake and its surrounding rivers? Is there any environmental impact caused by nitrate and phosphate load in Rawa Pening Lake?

### **1.7 Specific objectives of this study**

1. To measure the Nitrate and Phosphate concentration in Rawa Pening Lake, three of its input rivers (Panjang, Rengas, Galeh) and output river (Tuntang).



2. To study the environmental impact of nitrate and phosphate from fertilizers in Rawa Pening Lake

### **1.8 Benefits of research**

1. For the development of environmental science  
This study can contribute further understanding on the impact of fertilizers usage on the environment around Rawa Pening Lake.
2. For researchers  
Information provided here can be used as a reference, comparative data and basic consideration for researchers and observers of environmental problems in future studies.
3. For the community around Rawapening  
People can understand the condition of Rawapening and take actions to protect the lake.
4. For the government  
The government can make policy on the use of fertilizers based from findings found in this study in order to keep water pollution in Rawapening under control.