IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Biosorption Efficacy of *Sargassum wightii* (Greville ex. J. Agardh) from selected Fresh Water Bodies of Kanniyakumari District of Tamil Nadu

Anitha Kumari C.[1], Beena Lawrence[2], Sreelaja S [3] and Johnsi Christobel G.[1]

1,4Department of Botany and Research Centre, Nesamony Memorial Christian College Marthandam.

(Affiliated by M.S. University, Tirunelveli, Tamil Nadu, India).

2Department of Botany, Women's Christian College, Nagercoil, T.N., India

3Department of Botany, Sree Devi Kumari Women's College, Kuzhithurai, T.N., India

ABSTRACT

Biosorption process is a promising technology for the removal of heavy metals as it is fast, powerful and low cost, it takes place in a wide range of temperature as well as it can be used for almost all types of heavy metals. In this study, samples were collected from selected freshwater bodies of Kanyakumari district and subjected to biosorption efficacy evaluation using *Sargassum wightii* (Greville ex. J. Agardh). The present investigation showed biosorption of Cu and Zn by *S. wightii* in a batch system. Heavy metal analysis of water samples showed maximum values of Cu, Fe, and Zn in site IIwater compared to site I. Influence of contact time and concentration of adsorbate on the removal of heavy metals from selected water samples were also evaluated. Maximum heavy metal removal from the water samples from site I and site II were seen for Cu (28.57%), Zn (95.45%) and Cu (94.15%), Zn (95.74%) at 60 minutes of contact time with the macroalgae biomass. The highest percentage of heavy metal removal for Cu (42.85%), Zn (95.90%), and Cu (82.45%), Zn (97.44%), from site I and site II water samples respectively. The algal biomass of 3g/L was found to be best for removal of heavy metals from in site I water sample and 4g/L in site II water sample. The current investigation has shown that brown algae *S. wightii* could be efficiently used for the bioremediation of Cu and Zn heavy metal polluted fresh water bodies.

KEYWORDS: Biosorption, Copper, Heavy metal, *Sargassum wightii*, Zinc

INTRODUCTION

Heavy metals are released into the aquatic environment from several domestic sources (automobile exhaust, smelting processes, burning of fossil fuels, incineration of wastes, landfill leaches, use of sewage sludge, municipal wastewater, urban runoff) and industrial processes like electroplating, refining ore, mining, electronic and metal finishing industries, fertilizer industry, tanneries, painting, paper industries and pesticides (Gautam *et al*., 2015).The presence of inorganic pollutants such as metal ions in the ecosystem causes a major environmental problem. Toxic metal compounds coming to the earth's surface not only contaminate earth's water (seas, lakes, ponds and reservoirs), but can also contaminate underground water in trace amounts by leaking from the soil after rain and snow (Kilic *et al*., 2013). The numerous metals which are significantly toxic to human beings and ecological environments include chromium (Cr), copper (Cu), lead (Pb), cadmium (Cd), mercury (Hg), zinc (Zn), manganese (Mn) and nickel (Ni) (Meena *et al*., 2008).

Metal ions are reported as priority pollutants, due to their mobility in natural water ecosystems and due to their toxicity (Demirbas, 2008). The problem associated with metal ions pollution is that they are not biodegradable and are highly persistent in the environment and can be accumulated in living tissues, causing various diseases and disorders (Ngah *et al*., 2008). Heavy metal toxicity can result in damage or reduced mental and central nervous function, lower energy levels and damage to blood composition, lungs, kidneys, liver and other vital organs (Ahmaruzzaman, 2011). Hence, it is important to remove heavy metals such as Lead (Pb), Zinc (Zn), Copper (Cu) and Cadmium (Cd) which are common heavy metals that can be found in wastewater discharge.

Numerous methods such as chemical precipitation, ion exchange, coagulation–flocculation, flotation, membrane filtration, electrochemical treatment, magnetic separation and purification, biosorption and nanotechnology are being used for the treatment and removal of heavy metals from water and wastewater (Gautam *et al*., 2015).Among them, biosorption process has been regarded as a promising cost effective, sustainable and eco-friendly technology for the removal of different types of organic and inorganic pollutants from water and wastewater (He and Chen, 2014).

Seaweeds are widely distributed in marine, freshwater as well as terrestrial ecosystems, which can serve as good biosorbents due to their abundance, cost-effectiveness, reusability and high metal sorption capacities (Bilal *et al*., 2013; He and Chen, 2014).Algae biomass, in general, is an efficient adsorbent of heavy metals. Bio-treatment with microalgae is particularly attractive because of their photosynthetic capabilities, converting solar energy into useful biomasses and incorporating nutrients such as nitrogen and phosphorus causing eutrophication.

Heavy metals have a tendency to accumulate in selected tissues of human body and animals in general. These heavy metals have a high potential being toxic even at relatively minor levels of exposure.

The accumulation of heavy metals in the environment over a long period of time can cause both pollution and health risks. Metal poisoning occurs through inhaling the fumes and through ingestion of food contaminated with toxic metals. The heavy metals in soils can be absorbed by plants up to certain levels which are toxic and through ingestion by herbivores or omnivores, metal poisoning takes place. Children are also highly vulnerable to metal poisoning since they interact with toys contaminated with toxic metals (Maraga *et al*., 2016).

Trace amount of heavy metals are required by living organisms, but when they exceed the permissible levels, they cause various diseases and disorders as well as deleterious ecological effects, as they are toxic and non-degradable (Mustapha and Halimoon, 2015).

Zinc

Zinc can be found in wastewater from metallurgical processes, galvanizing plants, stabilizers, thermoplastics, pigment formation, alloys and battery manufacturing and discharges of municipal wastewater treatment plants (EI-Shafey, 2010). Zinc can enter the water supply through pipe fittings or zinc pipes used to pipe water. Low pH in tap water can increase the amount of zinc leached into the water. High amounts of zinc can cause nausea, diarrhea, internal bleeding, vomiting and abdominal cramps (WHO, 1996). Despite the importance of Zinc and Copper, as important minerals for living organisms, zinc at a concentration of more than 2 mg/L in wastewater causes irritation, stomach cramps, and lung disorders.

Copper

Long – term exposure to high doses of copper may cause copper toxicity, which is distinguished by nausea, fever, passing out, vomiting, abdominal cramps, diarrhoea and over time cause liver damage, kidney diseases, brain damage and heart failure (Jewell, 2019). Dissolved metals cannot be removed from the natural environment, so conventional methods for their removal have been studying extensively. These methods include chemical precipitation, ion exchange/chelation, adsorption on activated carbon, and membrane processes (Sharma, 2015; Morin-Crini *et al*., 2017). Copper sulfate can infiltrate the water supply through its use in mining industries. As copper sulfate is extremely soluble in water, it can easily seep into water bodies and supplies (Gamakaranage *et al*., 2011).

Ferrous

Iron is the most abundant transition metal in the earth's crust. The presence of iron in water with high concentration can affect water quality, chemistry, cause damage to the human body, affect the root system and growth of various wetland and river ecosystem species depending upon their tolerance mechanism (Papanikolaou and Pantopoulos, 2005).

BIOSORPTION

Biosorption, which uses the ability of biological materials to remove and accumulate heavy metals from aqueous solutions, has received considerable attention in recent years because of a few advantages compared to traditional methods. Biosorption uses cheaper materials such as naturally abundant algae or byproducts of fermentation industries as biosorbents and biosorptive process is generally rapid and is suitable for the extraction of metal ions from large volume of water.

Biosorption is defined as ability of biological materials to accumulate heavy metals from wastewater through metabolically mediated (by the use of ATP) or spontaneous physico-chemical pathways of uptake (not at the cost of ATP), or as a property of certain types of inactive, non-living microbial biomass which bind and concentrate heavy metals from even very dilute aqueous solution (Shamim, 2016). It is a complex process that depends on different factors like cell physiology, physicochemical factors such as pH, temperature, contact time, ionic strength, and metal concentration, chemistry of the metal ions, cell wall composition of microorganism (Joo *et al*., 2010). Biosorption of different heavy metals e.g. cadmium, silver, lead, nickel etc. by using microorganisms like fungi, algae or bacteria was studied by different groups (Hassan *et al*., 2009).

Heavy metals in the environment can be hazardous to the health and well being of most living species. Therefore these pollutants should be removed from industrial wastes before discharge into water streams (Volesky, 2001). Heavy metal pollution due to rapid urbanization and industrialization is one of the most significant environmental problems. Heavy metals have become a global issue of environment and public health concern due to their toxicities, bioaccumulation in human body and food chain, carcinogenicities and mutagenesis in various living organisms (Wang *et al*., 2013; Sarkar *et al*., 2014; Chowdhury *et al*., 2015). So the present study *S. wightii* a commonly available brown alga used to evaluate the biosorption efficacy in heavy metals in the selected pond water.

MATERIALS AND METHODS

Collection of sample

Water sample (pond) used for this study was obtained from Killioor Taluk, Kanyakumari district. It was stored at room temperature prior to use. Brown seaweed biomass used as the biosorbent for this work was collected from muttom coastal area.

Analysis of Water Sample for Heavy Metals

Water sample must be filtered to less than 0.45µm and preserved in the field by cooling to less than 4ºC within four hours of sampling. Lab personnel will acidify water samples to a pH less than 2 with ultrapure HNO_3 16 hours before ICP-OES analysis. Water samples will be analysed initially without dilutions. If concentrations are found to be above the highest calibration standards, subsequent dilutions will be required and appropriately documented. A Perkin Elmer Optima 2000 DV model ICP-OES was used to determine the heavy metals (Yener, 2019).

Batch biosorption studies

The dynamic sorption of the heavy metals present in selected water sample by the Brown algae biomass was investigated in batch mode. The batch biosorption study was carried out by contacting 3 g of the seaweed biomass with 300ml of the waste water in a 500ml flask. The flask was then agitated at 20 rpm on a water bath shaker for 60min at room temperature (28ºC). Then the sample solution was taken and immediately filtered using filter paper to remove the residue while the filtrate was analyzed for residual heavy metals using atomic absorption spectrophotometer.

The amount of heavy metal sorbed at time t,t_q was calculated according to Eq. (Xun*et al*., 2007).

$$qt = \frac{(Co - Ct)\mathrm{V}}{W}$$

Where *Ct* is the concentration of heavy metal in waste water at time *t*.

V is the Volume of waste water

W is the weight of seaweed sample
The percentage of heavy metal removal was calculated using Eq.

$$\text{Removal (\%)} = \frac{Co - Ct}{Co} \times 100$$

Optimum contact time determination

The optimum contact time for metal biosorption was determined by adjusting the selected water sample at different time intervals (10, 30, 60, 90, 120 min). The other parameters of pH and biomass dosage were fixed at 6 and 3g/L, respectively.

Optimum algal biomass dosage determination

The optimum biomass dosage for metal biosorption was determined by mixing the heavy metal solutions with different weights of the biomass (1, 2, 3, 4, 5g/L). The other parameters of pH and contact time were fixed at 6 and 60min, respectively.

RESULTS

Analysis of water sample for heavy metal

The results of heavy metal analysis of selected water sample are presented in Table1. The concentration of copper, ferrous, manganese and zinc were found to be ND, 0.021, ND, 0.012 (ppm) respectively in control. In site-I water sample it was found to be 0.014, 0.03, ND, 0.22 ppm for Cu, Fe, Mn and Zn respectively. In site-II water sample 0.171ppm in copper, 0.053ppm in ferrous, while manganese was not detected and 0.235ppm in zinc was present. From the Table 1 it could be noted that the maximum concentration of heavy metal was observed in site-II water sample.

Table : 1 Heavy Metal Analysis of Selected Water Sample

Sample	Concentration of Heavy Metals			
	Cu (ppm)	Fe (ppm)	Mn (ppm)	Zn (ppm)
Control	ND	0.021	ND	0.012
Site-I water	0.014	0.03	ND	0.22
Site-II water	0.171	0.053	ND	0.235

ND – Less than 0.01 ppm

Effect of Contact Time

Copper adsorption efficacy of *S. wightii* from site-I water

The copper adsorption efficacy of *S. wightii* from site-I water is given in Table 2 and Fig.1. From the table it could be observed that the adsorption efficiency increased with increase in contact time upto 60min. after which it is constant. Therefore, the optimum contact time was selected as 60min. Maximum adsorbed quantity of copper was 0.4mg/g. The highest percentage of Cu adsorption by *S. wightii* was 28.57%.

Table : 2 Effect of contact time on copper biosorption efficacy of *S. wightii* from site-I water

Contact time (t)	Cu (site-I)	
	Quantity adsorbed (q_t)	Percentage of heavy metal removal (%)
10	0.1	7.14%
30	0.2	14.28%
60	0.4	28.57%
90	0.3	21.42%
120	0.3	21.42%

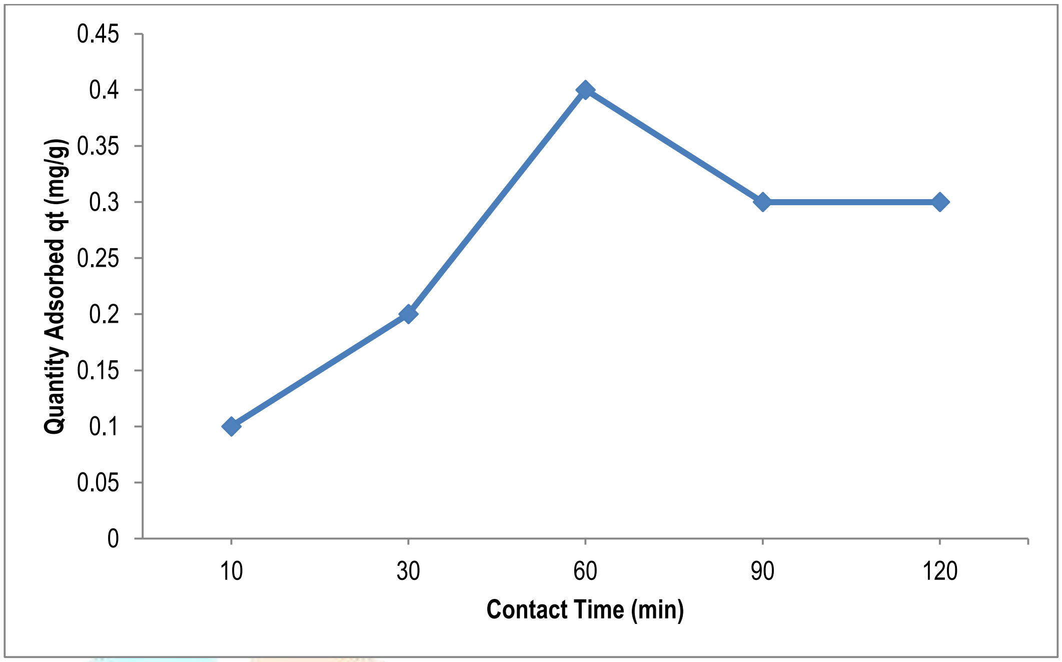

Figure: 1 Effect of contact time on copper biosorption of *S. wightii*

Zinc adsorption efficacy of *S. wightii* from site-I water sample

Biosorption of zinc on the adsorbent i.e. *S. wightii* increased with an increase in contact time upto 60min then it was gradually decreased. So the optimum contact time was selected as 60mts (Fig. 2). The maximum adsorption efficacy of *S. wightii* for the heavy metal zinc was 21mg/g at 60mts (Table: 3). The highest percentage of Zn adsorption efficacy of *S. wightii* from site-I water samples was 95.45%.

Table : 3 Effect of contact time on zinc biosorption efficacy of *S. wightii* from site-I water

Contact time (t)	Zn (site-I)	
	Quantity adsorbed (q_t)	Percentage of heavy metal removal (%)
10	20.0	90.90%
30	20.6	93.63%
60	21.0	95.45%
90	20.5	93.18%
120	20.3	92.27%

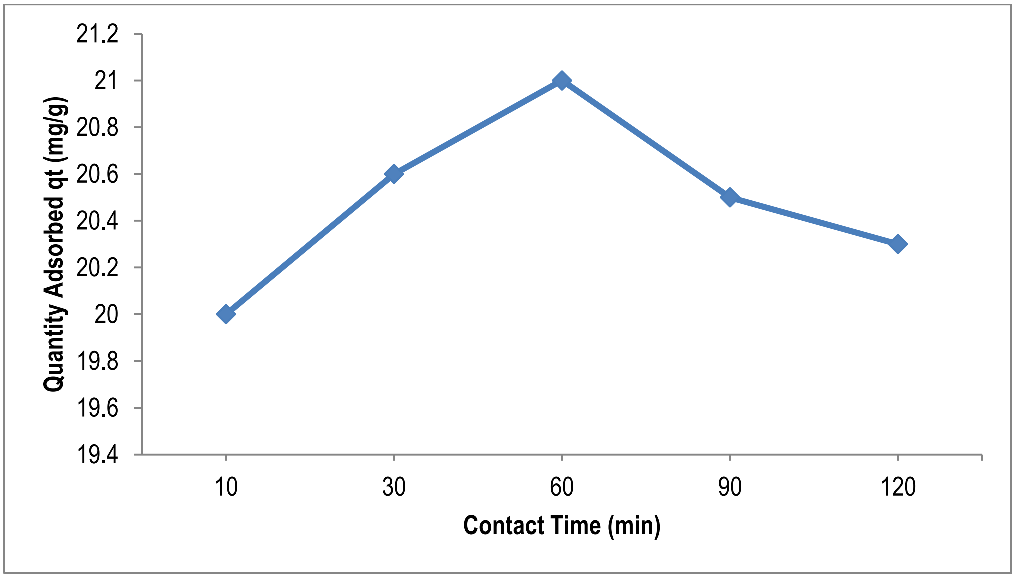

Figure : 2 Effect of contact time on zinc biosorption efficacy of *S. wightii*

Copper adsorption efficacy of *S. wightii* from site-II water sample

The data shown in Table 4 revealed that the copper adsorption efficacy of *S. wightii* was significantly enhanced with rise in contact time (upto 60min) with site-II water sample (Fig. 3). It was also observed that the adsorption efficacy of *S. wightii* was constant in this experiment. Maximum adsorption efficacy was 16.1mg/g at 60min. The highest percentage of adsorption was of Cu from site-II water sample was 94%.

Table : 4 Effect of contact time on copper biosorption efficacy of *S. wightii* from site-II water

Contact time (t)	Cu (site-II)	
	Quantity adsorbed (q_t)	Percentage of heavy metal removal (%)
10	14.8	86.54%
30	15.1	88.30%
60	16.1	94.15%
90	15.8	92.39%
120	15.5	90.6%

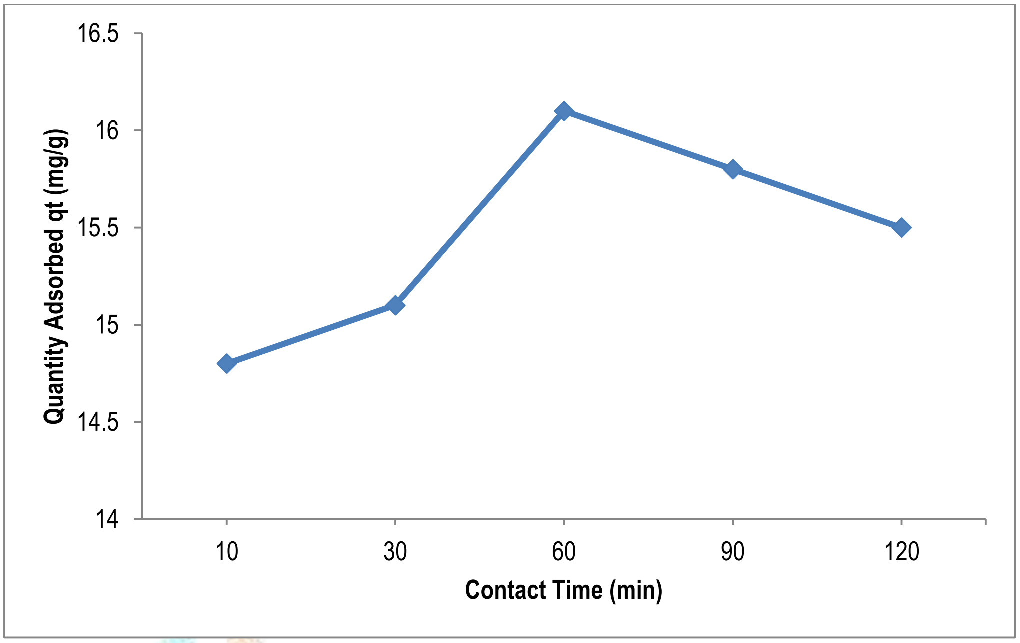

Figure: 3 Effect of contact time on copper biosorption efficacy of *S. wightii*

Zinc adsorption efficacy of *S. wightii* from site-II water sample

Table 5 shows the Zn adsorption efficacy of *S. wightii* from site-II water sample. From the table it could be noticed that the zinc adsorption efficacy of *S. wightii* was increased with an increase in contact time upto 60min. Above the contact time of 60 minutes the adsorption efficacy was gradually decreased (Fig. 4). Therefore, the maximum quantity of Zn adsorbed was 22.5mg/g at 60min contact time and the peak value of percentage of adsorption was 95.74%.

Table : 5 Effect of contact time on zinc biosorption efficacy of *S. wightii* from site-II water

Contact time (t)	Zn (site-II)	
	Quantity adsorbed (q_t)	Percentage of heavy metal removal (%)
10	20.9	88.93%
30	21.5	91.48%
60	22.5	95.74%
90	21.2	90.21%
120	20.5	87.23%

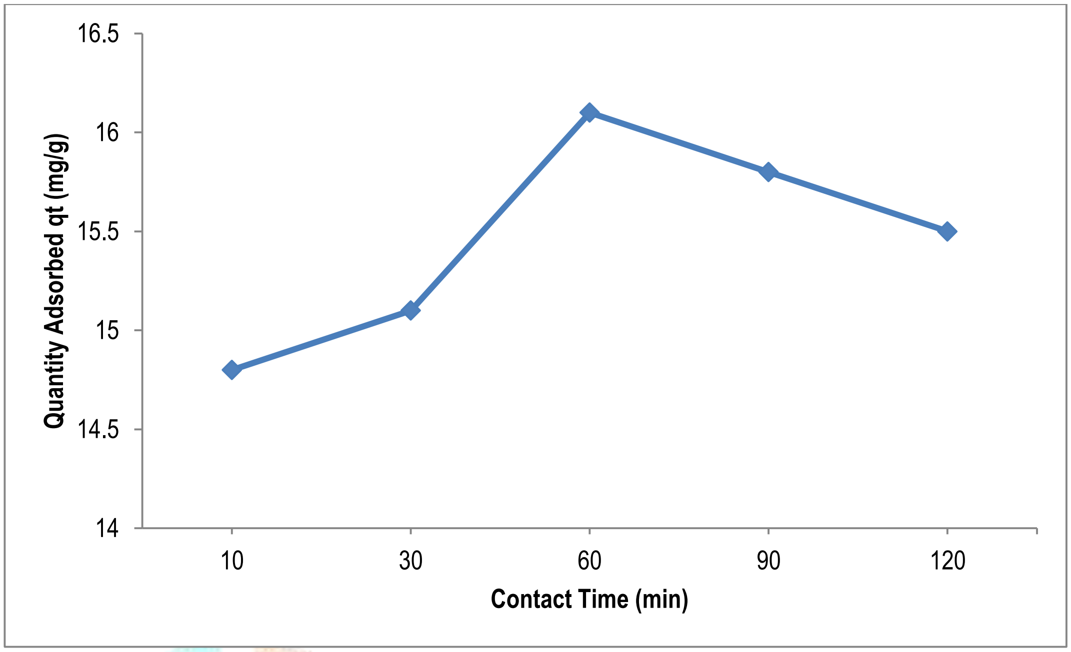

Figure: 4 Effect of contact time on zinc biosorption efficacy of *S. wightii*

Ferrous adsorption efficacy of *S. wightii* from site-I and site-II water

Ferrous ions was not adsorbed by *S. wightii*.

Effect of algal biomass dosage

Copper adsorption efficacy of *S. wightii* from site-I water

The copper adsorption efficacy of *S. wightii* from site-I water samples is given in Table 6 and Fig. 5. From the table it could be observed that the adsorption efficiency increased with subsequent increasing in the algal dosage upto 3g/L, where the biosorption capacity reached its maximum value (0.6mg/g) and the equlibirium between the sorbent and sorbate was attained. Afterwards the bioadsorption capacity was constant. The highest percentage of copper adsorption by *S.wightii* was 42.85%.

Table: 6 Effect of algal biomass on copper biosorption efficacy of *S. wightii* from site-I water

Biomass(g/L)	Cu (site-I)	
	Quantity adsorbed (q_e)	Percentage of heavy metal removal (%)
1	0.2	14.28%
2	0.3	21.42%
3	0.6	42.85%
4	0.5	35.71%
5	0.5	35.71%

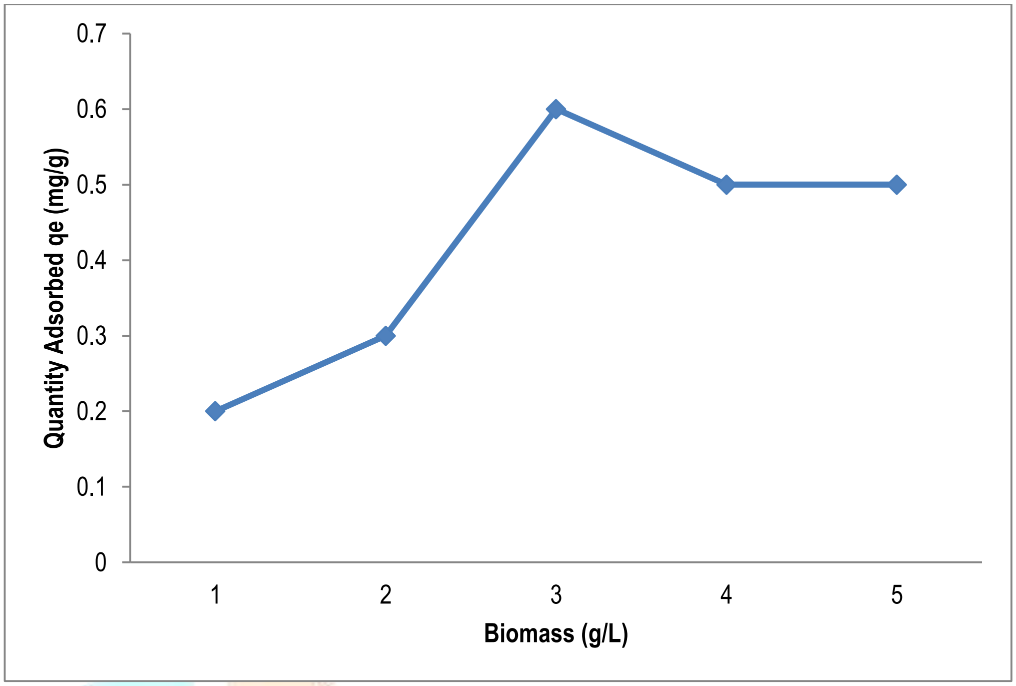

Figure : 5 Effect of algal biomass on copper biosorption efficacy of *S. wightii*

Zinc adsorption efficacy of *S. wightii* from site-I water

The effects of algal biomass on the adsorption efficacy of zinc from site-I water were investigated using different adsorbent concentrations ranging from 1 to 5g/L. As shown in Table: 7 and Fig.6, the adsorption efficacy of zinc by *S. wightii* was increased with increasing biomass concentration upto 3g/L (21.1mg/g) when equlibirium was attained. Further increase in algal biomass, no significant changes in adsorption was observed. Maximum removal percentage was 95.90%.

Table : 7 Effect of algal biomass on zinc biosorption efficacy of *S. wightii* from site-I water

Biomass(g/L)	Zn (site-I)	
	Quantity adsorbed (q_e)	Percentage of heavy metal removal (%)
1	20.3	92.27%
2	20.6	93.63%
3	21.1	95.90%
4	20.8	94.54%
5	20.8	94.54%

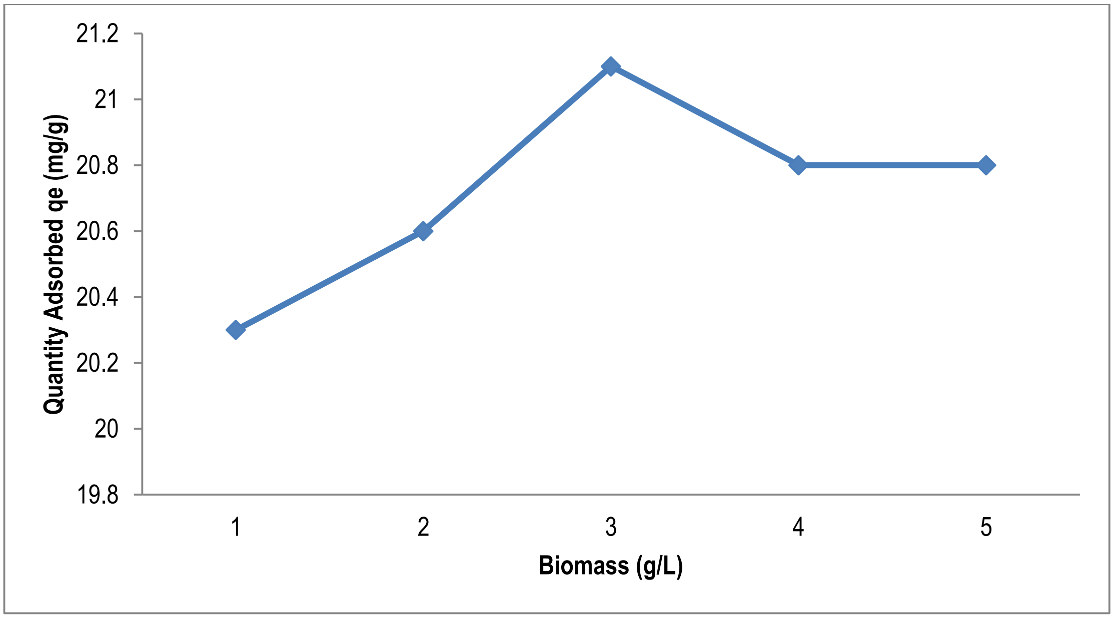

Figure: 6 Effect of algal biomass on zinc biosorption efficacy of *S. wightii*

Copper adsorption efficacy of *S. wightii* from site-II water

The data shown in Table 8 revealed that the copper adsorption efficacy of *S. wightii* was significantly enhanced with rise in algal biomass dosage upto 4g/L, then it was slightly decreased (Fig. 7). Maximum adsorption efficacy was 14.1mg/g. The highest percentage of adsorption of 82.45% was observed. So the optimum algal biomass was selected as 4g/L.

Table : 8 Effect of algal biomass on copper biosorption efficacy of *S. wightii* from site-II water

Biomass(g/L)	Cu (site-II)	
	Quantity adsorbed (q_e)	Percentage of heavy metal removal (%)
1	10.1	59.06%
2	11.1	64.91%
3	12.0	70.17%
4	14.1	82.45%
5	13.1	76.60%

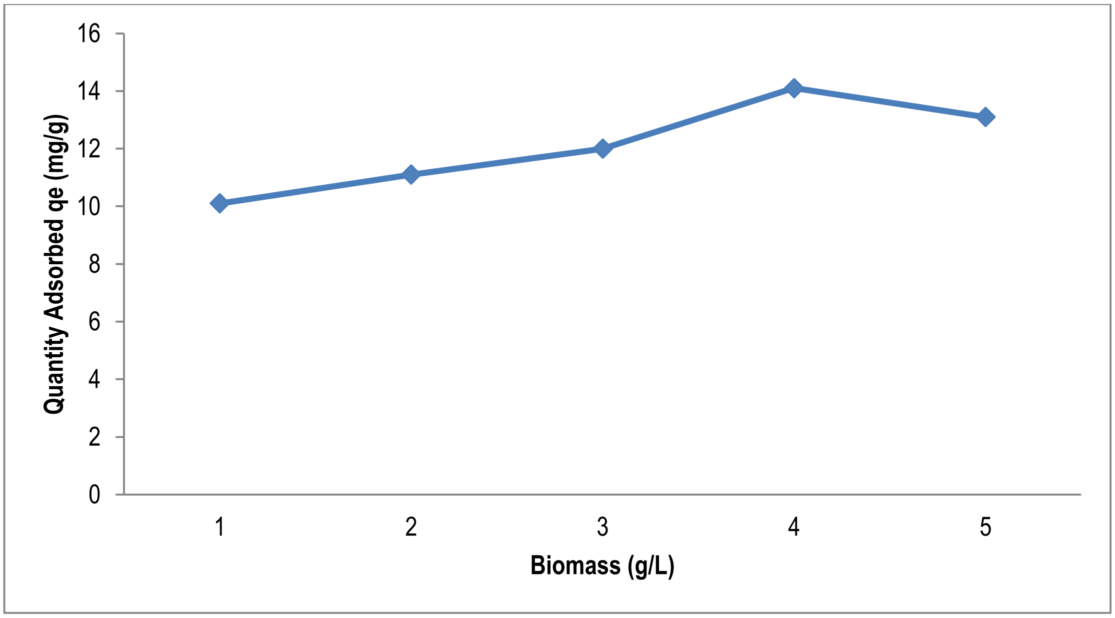

Figure: 7 Effect of algal biomass on copper biosorption efficacy of *S. wightii*

Zinc adsorption efficacy of *S. wightii* from site-II water

Table 9 shows the Zn adsorption efficacy of *S. wightii* from site-II water. The present study showed that the zinc adsorption capacity of *S. wightii* increased with increase biomass dosage upto 4g/L, thereafter it was decreased slowly (Fig. 8). In this experiment using different concentration of *S. wightii* from 1-5g/L, the maximum amount (or) quantity of Zn adsorbed was 22.9mg/g. The peak value of percentage of adsorption was 97.44%.

Table : 9 Effect of algal biomass on zinc biosorption efficacy of *S. wightii* from site-II water

Biomass(g/L)	Zn (site-II)	
	Quantity adsorbed (q_t)	Percentage of heavy metal removal (%)
1	21.2	90.21%
2	21.5	91.48%
3	22.5	95.74%
4	22.9	97.44%
5	22.6	96.17%

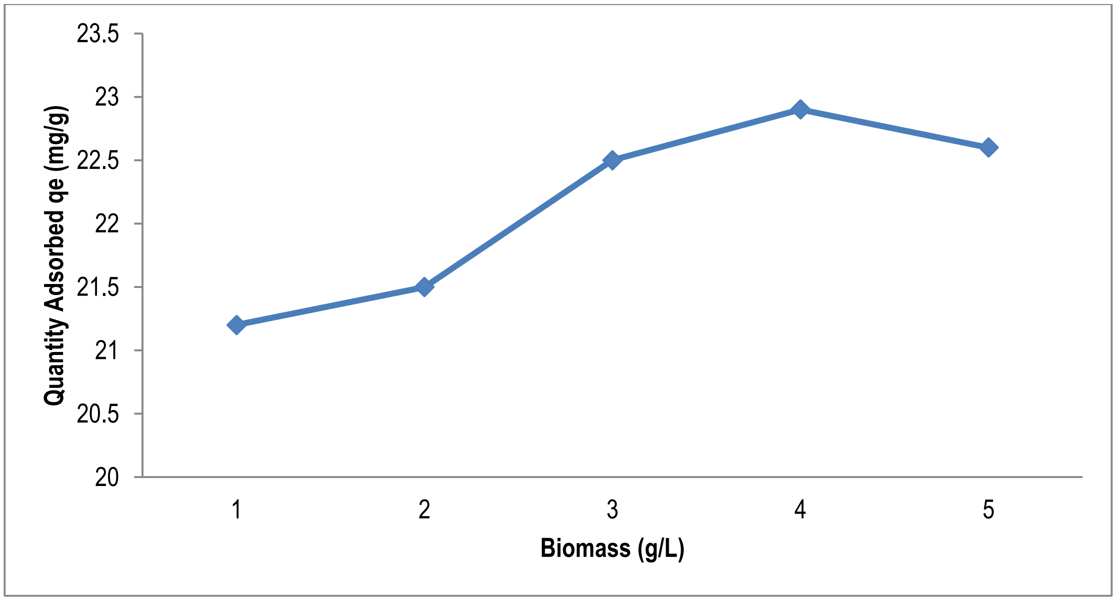

Figure: 8 Effect of algal biomass on zinc biosorption efficacy of *S. wightii*

Ferrous adsorption efficacy of *S. wightii* from site-I and site-II water

Ferrous ions adsorption was not detected by *S. wightii*.

DISCUSSION

A wide variety of active and inactive biomass such as bacteria, yeast, fungi and algae have been employed as biosorbents for removal of metal ions from aqueous solution (Wang and Chen, 2009). Among these biological materials, marine algae are proposed as one of the most promising biosorbents; particularly when they are existed in non-living forms, due to their high biosorption capacity, low cost, availability and renewability (He and Chen, 2014). Biosorption process is affected by factors like temperature, pH, contact time, metal ion concentration and biomass dosage. In the present study, biosorption efficacy of *S. wightii* a brown algae was tested for the removal of Cu, Zn, Fe, Mn from selected pond water in different contact time (10, 30, 60, 90, 120) because the contact time was also evaluated as one of the most significant factor affecting the biosorption efficiency.

Copper and Zinc adsorption efficacy of *S. wightii* at different contact time from Site-I sample

Result of the contact time experiment for the adsorption of Cu and Zn on to *S. wightii* revealed that the rate of copper adsorption was increased with increase in contact time upto 60min, after which it was constant. The high biosorption rate at initial contact time could be related to the high concentration gradient of solute, as well as abundance of vacant active sites on the algal surface (Wu *et al*., 2008). According to Li *et al*., 2010, the slow removal capacity during the later stages may be attributed to diffusion of metal ions onto the algal surface. Ibrahim, 2016 reported that the optimum removal condition of SAC (Sargassum activated carbon) and SAP (Sargassum algal powder) for the heavy metal Cu^{+2},Cd^{+2} and Pb^{+2} was found to occur at contact time 60mins. Present study agrees with the above author in the findings. In 2018, Ibrahim *et* *al*., reported that Cu, Pb, Ni, and Cd adsorption rate was significantly enhanced with rise in contact time upto 60 min, however no significant changes in adsorption was observed with further increase in contact time.

In the present study biosorption efficacy of *S. wightii* towards zinc was increased with an increase in contact time upto 60 min then it was gradually decreased. These findings agrees with Utomo *et al*., 2016, they found that marine algae was able to adsorb more Zn and Cu compared to other metals Pb, Cd within 60min. Similar findings were observed by Ibrahim 2016 in their studies in the adsorption of Cu^{+2}, Pb^{+2}, Cr^{+3} and Cd^{+2} ions by *Ulva lactuca* power and its activated carbon at different contact time (5-120min). The adsorption efficiency increases with rise in contact time upto 60min, after which it is more (or) less constant. Therefore, the optimum contact time was selected as 60min.

Copper and Zinc adsorption efficacy of *S. wightii* at different contact time from site-II sample

In the present study copper biosorption efficacy of *S. wightii* from site-II water was significantly enhanced with rise in contact time upto 60min, after that it was constant. This work was agreed with the findings of Ibrahim 2016. They also reported that the biosorption of metal ions Cu^{+2}, Cd^{+2}, Pb^{+2} by Sargassum powder and its activated carbon was increased with increase the contact time upto 60min, followed by a relatively slow biosorption process. Therefore, 60min was selected as optimum contact time for metal ion biosorption. According to Latinwo *et al*., 2015 the optimum contact time for biosorption of heavy metals such as Fe, Ca, Mg, K, Ag, Cr by green seaweed was 60min. Similar to this work Utomo *et al*., 2016 also reported that marine algae was able to adsorb more Zn and Cu compared to other metals (Pb, Cd) within 60min. It was observed that of Zinc adsorption efficacy of *S. wightii* from site-II water increased with an increase in contact time upto 60min, above that the adsorption efficacy was gradually decreased.

Effect of algal biomass dosage

Another important variable during metal uptake is the biomass concentration that can significantly affect the sorption process (Bagda *et al*., 2017). Biosorption is highly dependent on the initial adsorbent (biomass) concentration because the extent of biosorption is proportional to the special binding area, which can be defined as the portion of the total area that is available for biosorption (Li *et al*., 2015).

Copper and Zinc adsorption efficacy of *S. wightii* at different biomass dosage from site-I sample

In the present study biosorption efficacy of *S. wightii* of copper ion increased with an increase in biomass dosage upto 3g/L, then it remained constant. Maximum quantity of copper adsorbed was 0.6 mg/g. The maximum removal percentage was 42.85%. It was due to the increase in removal uptake at initial biosorbent doses could be attributed to the greater surface area of biosorbent, which in turn increased the availability of active sites for metal ions (Ibrahim *et al*., 2011). Similar results was reported by Ibrahim *et al*., 2018 in their studies on biosorption of heavy metals from synthetic waste water by different types of marine algae. Similar observation was observed by the study of Karthikeyan *et al*., 2007 and Rajasree *et al*., 2018.

Results of the biomass dosage experiment, revealed that the rate of Zinc adsorption increased with increase in algal biomass dosage upto 3g/L, then it was constant. So, 3g/L biomass dosage was selected as optimum absorption dosage. Maximum percentage of heavy metal removal was 95.96%. More or less similar findings was observed by Mahmood *et al*., 2017 in their comparative study of natural and modified biomass of *Sargassum sp*. for removal of Cd^{2+} and Zn^{2+} from waste water concluded that Zinc biosorption, 1g each of natural and acid treated biosorbent was enough to remove 76.7% and 91.1% Zn, respectively. While Anilkumar *et al*., 2016 reported that the observed enhancement in Zn (II) biosorption with increasing biomass dosage upto 15g/L. It could be due to an increase in the number of active binding sites available for metal uptake in the surface area of the biosorbent, however further increasing does not show a significant improvement.

Copper and Zinc adsorption efficacy of *S. wightii* in different algal biomass dosage from site-II sample

Copper and Zinc biosorption efficacy from site-II water by *S. wightii* increase with increase in biomass dosage upto 4g/L. After a slight decline was observed. The maximum adsorption quantity of Cu and Zn was 14.1% and 22.9 mg/g respectively. Maximum heavy metal removal was 82.45 and 97.44% of Cu and Zn respectively. There result were supported by a study of Ibrahim 2016 on the new trend for removing toxic heavy metals from drinking water by activated carbon based brown algae. He explained that adsorption of metal ions onto *Sargassum* Activated Carbon (SAC) increases as the adsorbent dosage between 2.0 and 0.8g/L. Considerable decrease in removal capacity was clearly noticed when algal dosage increased between 8.0 and 10.0g/L. The higher adsorption in initial biomass dosage could be due to the higher number of free binding sites. At low adsorption capacity of higher biomass dosage due to partial aggregation of biomass and a consequent reduction in intercellular distance, leading to the protection of binding sites from metal ions (Kannan *et al*., 2010 and Ding *et al*., 2012).

In the present study it was noticed that *S. wightii*, a brown algae removed zinc most efficiently than copper from selected samples. Similar findings was observed by Bina *et al*., 2019 in their study on biosorption and recovery of copper and zinc from aqueous solution by nonliving biomass of marine brown algae of *Sargassum sp*. and reported that the species of brown algae removed zinc most efficiently than copper from aqueous solution.

CONCLUSION

In this study, it shows that brown algae *Sargassum wightii* biomass are efficient heavy metal adsorbents. The biomass dosage and contact time play roles in the effective biosorption of heavy metals. It was also observed that *S. wightii*, effectively removed zinc most efficiently than copper from the water samples. This technique can be effectively used as a low cost and non pollutant biosorbent for bioremediation of heavy metal polluted fresh water bodies.

REFERENCE

- Ansari, KK & Prakash, S, 2000, Liminological studies on Tulsidas Tal of Tara region of Balrampur in relation to fisheries, poll. Res, Vol.19, no.4, pp.651-655.
- Asok, V, Jobail, NM & Reghunath, R, 2015, Water quality index determination of Ponds in Anand Panchayath, Thiruvananthapuram, Kerala, A Geospaital Approach, In. J. Of Sci and Res. Pub, Vol.5, no.12, pp.94-98.
- Augusthy, PO & Sherin, MA, 2001, Effect of factory effluents on seed germination and seedling growth of Vigna radiata L, J. Env. Res, Vol.22, no.92, pp.132-139.
- Brady, NC & Wel, RR, 2002, The Nature and Properties of Soils.13thed.Pearson education,Inc.,New Jersy.httpL//www.soil survey.org/tutorial/page10.asp, Retrieved on 3/12/2012.
- Berendse, F, van Ruijven, J, Jongejans, E, & Keesstra, S, 2015, Loss of plant species diversity reduces soil erosion resistance, Ecosystems, Vol.18, pp. 881-888.
- Brevik, EC, Cerda, A, Mataix-Solera, J, Pereg, L, Quinton, JN, Six, J, & Van Oost, K, 2015, The interdicipilinary nature of soil. Vol.1, pp.117-129, doi:10.5194/soil-1-117-2015.
- Bhatnagar, A, Jana, SN, Garg, SK, Patra, BC, Singh, G & Barman, VK, 2004, Water Quality Management in Aquaculture, In:course Mnual of Summer school on Development of sustainable Aquacultre Technology n Fresh and Saline waters, CSHargyana Agriculture Hisr (India), pp.203-210.
- Chauthan, NB & Thakor, FJ, 2012, A study of water quality index(W.Q.I)of Heranj Lake, Dist. Kheda-Gujarat.Asian J. Ex. Biol. Sci, Vol.3, no.3, pp.582-588.
- Dsh, AK, 2012, Impact of Domestic waste water on seed Germnaton and Physological parameters of Rice and Wheat, IJRRAS, Vol.12, no.2.
- Olaynka, BV & Arinde, OO, 2012, Effects of Spent Engine oil on Germination and seedling Growth of Groundnut (*Arachis hypogea* L.), Insight Ethnopharmacology, Vol.2, no.1, pp.5-9.
- Decock, C, Lee, J, Necpalova, M, Pereira, EIP, Tendall, DM & Six, J, 2015, Mitigating N2 O emissions from soil : from patching leaks to transformative action, Soil, Vol.1, pp. 687-694.
- Huy, V, & Iwai, CB, 2017, Utlization of wastewater on seed germination and physiological parameters of rice, Materials science and Engineering 334(2018)012036.doi:10.1088/1757-899X/334/1/012036.
- Julius, OO, Turay, A & Momh Raymond, R, 2015, Economic Assessment of Integrated fish farming (Fish-Rice-Piggery)in Sierra Leone, Agric Forest Fisheries, Vol.4, pp.87-94.

- Kajiru, GJ, Mrema, JP, Mbilinyi, BP, Rwethumbza, FB, Hatibu, N & Mowo, JG, 2015, Assessment of soil Fertility status under rain water Harvesting systems in the Ndala River catchment Northwest Tanzania, International water management Institute.
- Karur, V & Sharma, G, 2017, Impact of Dairy Industrial Effluent of Punjab (India)on seed germination and Early Growth of Triticumaestivam, Indian Journal of Science and Technology:10(16).DOI:10.17485/ijst/2017/v10 i 16/114311.
- Khaleel, RI, Ismal, N, Ibrathim, MH, 2013, The impact of waste water treatments on seed germinaton and Biochemical parameter of Abelmoschus Esalentus L. Procedia-Social and Behavioral Sciences, Vol.91, pp.453-460.
- London, JR,.1991, Bookler Tropical Soil Manual:A Handbook for sol survey and Agricultral L and Evaluation in the Tropics and Subtropics. Newyork: Hrlow, Essee, England: Longman Scientfic & Technical, pp.474.
- Muthalagi, S and Mala, S, 2007, Impact of sew on germination of *Brassica nigra* and Trigonella Foenm. J. Ecotoxial. Environ. Monit, Vol.17, pp.55-60.
- Marbet, REI, Brahli, A, Anibat, I and Bessam, F, 2000, No-tillage technology :Research view of impacts on soil on soil quality and wheat production in semiarid morocco.In:cantero-Martine Z,C-and Gabina,D.(eds) Mediterranean rain fed agricultural strategies for sustainability ZaragozaLCHEAM, 2004.pp.133-138.
- Moradi, S, Heidari, H, Saeidi, M and Nosratti, I, 2016, Effect of sewage-contaminated water on seed production ,heavy metals accumulation and seedling emergence in OAT, Glob Nest J, Vol.18(2), pp.392-38.
- Ming-Rong, L, and Huang, CH, 2013, Advanced science letters. Vol.19, pp.2927-2930.
- Niroula, B, 2003, Comparaive effects of Industrial effluents and sub-metropolitan sewage of Biratagar on Germination and Seedling growth of Rice and Blackgram, Our Nature, Vol.1, pp.10-14.
- Paraprov, A, Hambright, KD, Hakanson, L, and ostapenia, A, 2006, Water quality qualification: Basics and implementation, Hydrobiologia, Vol.560, pp.297-237.
- Prashar, C, Dixit, S, and Shrivastava, R, 2006, Seasonal varation in Physio-chemical characteristics in upper lake Bhopal, Asian J. E. Sci, Vol.20(2), pp.297-302.
- Rukera, TS, Mutanga, O, Micha, JC, 2011, ‘Optimization of an Integrated Rabbit Fish-Rice system for sustainable Production in Rwanda’, Rwanda. J., Vol.24, pp.1259-1276.
- Stevens, C, 2007, Dissolved oxygen, Sci and Technol, 5:1-5 *Aquaculture Networks*, Vol.1, pp.14-16.

- Solomon, W, Olabunde, GO, Matur, BM, 2013, Some physicochemical parameters of selected fish ponds in Gwagwalada and Kuje Area Concils, Federal capital Territory, Nigeria, Glo. Adv. Res. J. Agric. Sci., Vol.2(1), pp.017-022.
- Sangeetha, P, and Neha, P, 2015, Monitoring of seasonal variation in physico chemical water parameters in Nalasopara Region. J Ecosys Ecograph., Vol.5, pp.156.
- Singh, MR, Gupta, A and Beateswari, KH, 2010, Physico chemical properties of water samples for Manipur River system India, J.Appl.Sci.Environ.Manage (JASEM), Vol.14, pp.85-89.
- Sajitha, V and Vijayamma, SA, 2016, Study of physico-chemical parameters and pond water quality Index at Athiyannoor Panchayat, Kerala, India, Emer Life Sci Res, Vol.2(1), pp.46-51.
- Sharma, V, Sharma, R and Sharma, KD, 2002, Distillery effluent on seed germination, early seedling growth and pigment content of sugar beet (*Beta vulgaris* hinn. vari. poly), J. Envron. Bol., Vol.23, pp.77-80.
- Sargaonkar, A and Deshpande, V, 2003, Development of an overall Index of Pollution for Surface water Based on a General classification scheme in Indian context, Environment Monitoring and Assessmet, Vol.89, pp.43-67.
- Smith, P, Cotrufo, MF, Rumpel, C, Paustian, K, Kuikman, PJ, Elliott, JA, McDowell, R, Griffiths, RI, Asakawa, S, Bustamante, M, House, JI, Sobocka, J, Harper, R, Pan, G, West, PC, Gerber, JS, Clark, JM, Adhya, T, Scholes, RJ, and Scholes, MC, 2015, Biogeochemical cycles and biodiversity as key drivers of ecosystems services provided by soils, SOIL, Vol.1, pp.665-685, doi: 10.5194/soil-1-665-2015.
- Vaux, HJ 2001, Water Quality(Bppk Review), Environment, Vol.43(3), pp.39.
- Wang, Jia, CR, Wong, CK, Wong, PK, 2000, Characterization of polycyclic aromatic hydrocarbon created in lubricating oils', water Air soil Pollut, Vol.120, pp.381-396.
- Zheng, S, Jang, J, He, M, Zou, S, Wang, C, 2016, Effect of Kelp waste Extracts on the Growth and Development of Pakchoi (*Brassica Chinensis* L.).*www.nature.com/scientific reports*/6:38683/DOI:10.1038/srep 38683.