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Use of aquatic plants in removing pollutants and treating the wastewater: A review

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This study illustrates the importance of aquatic plants in removing pollutants and treating wastewater. Aquatic plants provide many benefits to humans, with many new applications still to be identified. However, introducing aquatic plant species that become problematic under specific conditions is putting both marine and freshwater environments at risk right now. These plant species are frequently imported from other regions for medicinal or horticultural purposes, but they eventually escape domestication and establish natural populations. Other pollutants, such as hydrocarbons and other hazardous and carcinogenic substances, can be removed from water using these aquatic plants. The application of growth-promoting bacteria that stimulate the growth of rhizosphere plants and the overgrown plants could be another modification that can have the maximum treating effect. Aquatic plants have many applications in wastewater treatment due to their much lower cost and higher efficiency. Numerous studies have proved Aquatic plants to be sinks for wastewater treatment, and they are also used in the treatment process and to reduce or limit pollutant wastewater. The treated wastewater was of acceptable quality, according to the international effluent standards for irrigation.

Keywords: Wastewater, aquatic plants, pollutant, wastewater treatment, wastes, irrigation.

INTRODUCTION

Plants are the primary source of food, fiber, and fuel. However, several aquatic plants can help remove pollutants in wastewater. Toxic pollutants in artificial chemicals have increased dramatically in ecosystems in recent years. Toxic pollutants such as solvents, pesticides, dyes, and other chemicals are mixed into water sources, causing ecological damage. Aquatic plants are highly useful in removing such damaging pollutants. Water Typha, Colocasia Hyacinth, Canna, Arabica, and other aquatic plants are used to remove damaging pollutants from water. These aquatic plants absorb organic and inorganic pollutants in a competitive environment. Phytoremediation is the name for this technique (Garad, 2022; and Anning *et al*., 2013).

Contaminated water, along with a scarcity of water, has placed a significant strain on the ecology. As a result of climate change, food demand, fast urbanization, and uncontrolled usage of resources of nature, Water scarcity affects over 40 % of the world's population (Ali *et al*., 2020; and Connell, 2018).

Releasing waste material and residuals in water bodies can be lethal to marine ecosystems, posing serious dangers to natural environments and human life. As a result, wastewater should be properly treated and refined before being released into the environment. Currently, traditional wastewater treatment methods aren't always useful in decreasing contaminants from the water. Hence, small amounts of pollutants can still be present in the treated water. Because of the pollutants' toxic nature, these materials may endanger the habitat and affect many cellular functions in plants (Ahmadi *et al.*, 2020; Mohebi, and Nazari, 2021).

Polluted wastewater is extremely harmful to aquatic human health and the environment (Ahmed *et al*., 2017; Carstea *et al*., 2016; and Mendoza *et al*., 2015). The only remaining alternative for meeting the expanding demand for water in the agricultural and industrial sectors has been wastewater reclamation (Tee *et al*., 2016).

The current study illustrates an environmentally favorable method for aquatic plants to remove pollutants and treat wastewater. In addition, this review article covers the future uses of aquatic plants as contamination bioindicators with pollutants and treating the wastewater.

***Pollution Of Wastewater*:** Large quantities of polluted wastewater are discharged into the environment due to industrialization, rising population, and urbanization (Rezania *et al*., 2015), about 359.4×109 m^3/year (Jones *et al*., 2021).

According to the United Nations, a percent of all public and industrial wastewater is released in developing countries

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without being treated (Joseph *et al*., 2019). Wastewater is utilized for irrigation in developing countries with limited water supplies, posing a health concern to all people (farmers and consumers) while providing agricultural systems with nutrients (Werner *et al*., 2018).

Non-biodegradable heavy metals (HMs) (zinc (Zn), nickel (Ni), copper (Cu), chromium (Cr), mercury (Hg), cadmium (Cd), lead (Pb), and Arsenic (As)) may be present in wastewater, as well as a significant amount of agriculturally important nutrients (Turan *et al*., 2018).

As a result, environmentally sustainable wastewater treatment technologies that allow for the reuse of important nutrients are gaining traction worldwide (Rezania *et al*., 2015).

Metalloids are metals and semi-metals that have been connected to pollution and probable toxicity or ecotoxicity. The term "heavy metals (HMs)" has been widely used in recent decades. Legal norms may create a list of "HMs" they apply to; these lists differ by country, and sometimes the term is used without defining which HMs are shown (Duffus, 2002).

HMs are metallic elements with a high atomic weight and a density of at least five times that of water. They are non-biodegradable and unable to decompose. As a result, they are always dangerous compounds (Paul, 2017; and Goher *et al*., 2017). A major concern is the increased risk posed to and by water bodies. To the potential for toxicity, bioaccumulation, and persistence, HMs are regarded as one of the most dangerous pollutants in the environment.

To their carcinogenic and poisonous properties and their other detrimental effects on public health, HMs are of particular concern. Furthermore, HMs pollution is an issue since many drinking water treatment procedures in impoverished nations, such as chlorination, sun sterilization, and boiling, are inadequate at removing HMs (Joseph *et al*., 2019).

HM, pollution has been caused by natural processes like as air deposition and volcanic eruptions. HMs can form as a result of a variety of factors, including as normal erosion and weathering, as well as human activities (Brevik and Burgess, 2015). Normal sources of HMs from rock weathering and leaching in the environment are generally of little consequence given the high level of natural activity that defines the modern world (Paul, 2017; Goher *et al*., 2017; Tchounwou *et al*., 2012; and Elbehiry *et al*., 2019**)**.

Bio-geochemical processes can also release HMs into the environment (Chowdhury *et al*., 2016). Despite allowed guidelines and updated legislation, metal ions are commonly emitted as dangerous pollutants in aqueous effluents from various metalworking, coal mining, chemical, electrolytic plating, and pharmaceutical sectors (Humelnicu *et al*., 2020). HM pollution is also produced by metallurgical industries, HM-containing paints, coatings, pigments, pesticides, and fertilizers, electronics, coal-fired power plants, petroleum combustion, microelectronics, galvanization, chemical, pharmaceutical, plastics, fabric, and electroplating industries, battery, high voltage lines, refineries, and paper mills, (Paul, 2017).

Aside from industrial activity, the photo engraving method, also known as metal engraving, photochemical treatment, or chemical milling, can expose water sources to metal ions in varying quantities and combinations. Every year, large quantities of agricultural waste are produced across the world. A portion of these agricultural wastes is dumped straight into bodies of water, causing severe water pollution. Moreover, removing kitchen waste into untreated or inadequately treated wastewaters can have a variety of harmful environmental repercussions, including the introduction of HMs. These metals become harmful to humans and other biosystems when their sensitivity level is exceeded. As a result, HM water pollution is a substantial concern in several developing nations, affecting both the quality of drinking water and the aquatic ecosystem. As a result, HM levels must be carefully managed and monitored to ensure that they meet environmental standards for each kind of water supply (Chowdhury *et al*., 2016; Goher *et al*., 2017; Paul, 2017; Elbasiouny *et al*., 2020; Humelnicu *et al*., 2020; and Mostafa *et al*., 2020**)**.

Based on European water regulation, the annual average ecological quality standards (AA-EQS) for internal groundwater are < 1.2 and 0.25 μg/L for Pb and Cd, respectively. The greatest permitted amounts of Cd and Pb in natural water for human preventive care are 0.72 - 1.8 and 2.5 - 65 μg/L, respectively. Recommendations for Pb and Cd content in drinking water are 0.01 and 0.003 μg/L, respectively, according to the World Health Organization (Yap *et al*., 2017; Elbehiry *et al*., 2018; and Grenni *et al*., 2019).

Because HMs are one of the highest priority contaminants and are quickly becoming one of the most critical environmental issues, several national authorities have enacted rigorous laws and restrictions (Karkra *et al*., 2017).

Metals (Co, Cu, Cr, Fe, Mg, Mn, Mo, Ni, Se, and Zn) have been recognized as essential elements for various physiological and biochemical activities. Other metals (Al, Sb, Ba, Cd, Au, In, Pb, Hg, Pt, Ag, Sr, Sn, Ti, V, and U) are non-essential since they have no known biological roles (Tchounwou *et al*., 2012).

Most of these HMs are considered elemental residues, found in low amounts (ppb: < 10 ppm) in various matrices of the environment. Many physiological disorders are associated with toxicity and carcinogenicity caused by heavy metals, that are unknown. Each metal, on the other hand, is understood to have its particular physical and chemical characteristics, this provides it with ecological methods of operation (Tchounwou *et al*., 2012).

Acute human exposure to high levels of HMs can result in cancer, Parkinson's, Alzheimer's disease, and anemia, as well as harm to the gastrointestinal, neurological, skeletal, and cutaneous systems (Brevik, and Burgess, 2015; and Goher *et al*., 2017**)**.

Municipal waste, unprocessed wastewater from various industries, and agrochemicals have all been dumped in open lakes and rivers at alarming rates, causing HM content to rise and water quality to worsen (Ali *et al*., 2016). The rising need for clean water in many regions of the world, as well as the remediation of water pollution, has now become a critical problem due to the causes mentioned above (Yap *et al*., 2017).

***Treatment Of Wastewater*:** HMs, unlike organic pollutants, do not degrade and can levels in the food system, causing various diseases. As a result, to solve pollution problems, HMs need to be removed from the water or soil. Reduced bioaccumulation of HMs, and hence their accumulating and damage in animals and plants, is one of the most significant aims of remediation (Wang, and Liu, 2018; Elbasiouny and Elbehiry, 2017**)**.

Pollution of air (not a chemical, but on the WHO list), cadmium, Arsenic, benzene, asbestos, dioxin, and dioxin-like compounds, mercury, lead, inadequate or excess fluoride, and very toxic pesticides are among the top 10 dangerous chemicals (WHO, 2011), Arsenic, cadmium, lead, and mercury are examples of heavy metals. Before being recycled from industrially polluted wastewater, essential metals must be removed from the aqueous solution (Vollprecht *et al*., 2019)

It is necessary to design affordable solutions and produce minimal additional waste. To reduce HMs and organic compounds from wastewater, microorganisms were used as biosorption. Both alive and dead, microbial cells are employed to convert or adsorb HMs and their derivatives, and they can be powerful bio-accumulator systems (Gupta, and Balomajumder, 2015**)**.

Many investigations have found that agricultural waste adsorbents have great adsorption ability for eliminating HMs (Kumar, and Chauhan, 2019**)**.

One of the most appealing recent research fields is the creation of ecologically friendly and effective wastewater treatment solutions. Phytoremediation is a natural treatment technology capable of reducing pollutants from wastewater. Today, the objective is to find a long-term solution for increasing treating wastewater ability (Rezania *et al*., 2015).

Pollution-removal techniques for wastewater

***Environmentally friendly vs. traditional treatment techniques*:** Polluted aqueous solutions have been prioritized for treatment before they reach natural water bodies (Ahmad *et al*., 2018).

Bioremediation, electrocoagulation, chemical precipitation, membrane separation, ion-exchange resins, adsorption, coagulation, reduction, reverse osmosis, evaporation, solvent extraction, and flocculation are all methods for removing HMs from aqueous solutions. Each of these methods has advantages and disadvantages; however, the majority of them are expensive, ineffective when it comes to reducing HMs from large volumes of water, and have advantages such as non-selectivity, high energy consumption, and the use of chemical products, all of these factors need careful disposal of the harmful waste produced **(**Grenni *et al*., 2019; Ahmad *et al*., 2018; and Doula, 2006).

Adsorption is the most promising of the numerous HM elimination methods because of its highly efficient, low cost, simple design, and ease of use **(**da-Silva *et al*., 2018; Lin *et al*., 2019; and Patil *et al*., 2019).

Many sectors prefer adsorption, which is regarded as a trustworthy recent technique. Activated carbon, fly ash, peat, woody biomass, zeolites, sewage sludge ash, and other biomaterials have all been shown to have a high potential to remove specific metals (such as lead and cadmium) from wastewater (Yap *et al*., 2017).

HMs have been efficiently removed from aquatic environments using a variety of aquatic plants, including water primrose (Ludwigia stolonifera), water hyacinth (Eichhornia crassipes), blue water well (Veronica anagallis-aquatica), and duckweed (Lemna gibba). The HMs can be absorbed and immobilized by living organisms in aquatic systems, which eventually accumulate as solid wastes, leaving cleaned aqueous solutions. The low cost and convenience of processing are two significant advantages of this method; all that is required is for the plants to develop organically (Saleh *et al*., 2020).

The dissolved elements are removed from the aqueous media by adsorption on the roots or translocation in the plant shoot, and the elements are then stabilized through physical and/or chemical interactions. As a result, phytoremediation is being used to treat HM-contaminated wastewater more often. Although many terrestrial and aquatic plants have been studied, it is still important to evaluate their performance and efficacy in a range of situations in most cases. There's also a need to look at plants that haven't been studied for their ability to purify aquatic ecosystems (Saleh *et al*., 2020; and Elbehiry *et al*., 2020).

***Treatment of wastewater with low-cost adsorbents*:** Further expansion in this sector needs increased performance at manageable prices to raise industrial profit margins. Agricultural wastes have gained much attention because of their global availability and abundance (Thines *et al*., 2017; and El-Ramady *et al*., 2020).

Adsorbents at a low cost can be useful in treating polluted wastewater. Because of their porous architectures, clays, zeolites, alumina, solid wastes, and activated carbon have been used in long-term adsorption, but the primary issue restricting their usage is the generation of potentially harmful solid wastes. Alternatively, many low-cost adsorbents have a limited adsorption potential, necessitating more study to enhance their composition and performance before they can be employed in widely used applications (Pourrahim *et al*., 2020).

Agricultural wastes can also be used as sorbents to aid with the environmental challenges of green garbage disposal and management. Wheat bran, maize cobs, tree leaves, barks, rice husks, and aquatic weeds are just a few of the green wastes that have been studied for their ability to absorb HM (Malakahmad *et al*., 2016).

Activated carbon is commonly utilized in wastewater treatment as an excellent adsorbent (Grenni *et al*., 2019). It's amorphous and porous, having a large surface area for adsorption HMs or other compounds (Tatarchuk *et al*., 2019). Natural resource conservation and the effective use of nonrenewable energy sources have spurred the recycling of organic wastes as an alternative to dumping and burning. However, there are significant challenges in its regeneration, which makes treating tainted water expensive, which is a particular difficulty in impoverished nations. As a result, low-cost, locally available materials with good adsorption capabilities are required. The development of innovative green remediation methods based on plants or vegetable wastes is becoming more and more of a priority. The development of innovative sorbents based on solid waste (e.g., plant biomass) for eliminating HM from water might be a cost-effective solution to reduce treatment expenses (Grenni *et al*., 2019).

***Mechanisms of aquatic plants to treat wastewater*:** Natural treatment systems are one of the most suitable treatment technologies for various wastewaters, attracting much attention in recent years. Natural systems include natural soil systems, aquatic systems, and wetlands. These systems rely on renewable energies such as solar, wind, and stored energy in biomass and soil. After stabilizing the pond system, one of the natural treatment systems that have been considered in many countries in the last few decades, especially in developed countries, is the wastewater treatment system with plants' help (phytoremediation) or wetland systems. Nowadays, understanding plants' ability to help decompose and purify pathogenic microorganisms and the excretion of many contaminants, has led to increased application of plant systems and a more comprehensive range of research in this area (Keddy, 2010).

The primary role of plants in this system is to supply the oxygen required by heterotrophic microorganisms in the root zone, absorb nutrients, increase, and stabilize the hydraulic conductivity of the substrate. As a high-efficiency secondary treatment unit, wetlands can reduce the number of contaminants including organic matter, inorganic matter, and a variety of pathogenic microorganisms to an acceptable level (Vymazal, 2010).

The success of short- and long-term treatments to accomplish rehabilitative goals, pollutant reduction effectiveness, pollutant toxicity reduction, and cost-effectiveness are some of the criteria for land treatment or technology selection (Abdullah *et al*., 2020).

Plant species that are abundant, such as lichens, planktons, and higher plants, usually contribute basic information about the health of an ecosystem. Plants are extremely sensitive tools for predicting and recognizing ecological stressors. As a result of industrialization and urbanization, pollution of land and marine environments has increased recently (Zaghloul *et al*., 2020). Because most plants are stationary and quickly strike a balance in their natural environment, they help to estimate the contaminated ecosystem status (Zaghloul *et al*., 2020).

Aquatic plants are the water's primary source of food and oxygen. They are critical for the preservation of biological equilibrium in the aquatic ecosystem. Aquatic plants are the water's primary source of food and oxygen. They are critical for the preservation of biological equilibrium in the aquatic ecosystem (Kumar, and Arisdason, 2020).

The marine environment is a resourceful and cost-effective cleanup method for aquatic plant treatment of a broad contaminated region. Aquatic plants reduce pollutants and Heavy metals naturally (Pratas *et al*., 2014).

The most efficient and cost-effective method for removing heavy metals and other environmental pollutants is using aquatic plants (Guittonny-Philippe *et al*., 2015). Aquatic plants and constructed wetlands have long been used to treat wastewater worldwide (Gorito *et al*., 2017; and Mesa *et al*., 2020).

The selection of aquatic plant species for heavy metal accumulation is essential to aquatic plant treatment (Galal *et al*., 2014). Aquatic plants have earned an excellent reputation for their capacity to clean up polluted environments all across the world throughout the years (Gorito *et al*., 2017). Aquatic plants have a complicated root structure that enables them to collect contaminants in their roots and shoots, making them an excellent choice for this (Ali *et al*., 2020). The development and culture of aquatic plants take time, which might hinder the expanding demand for aquatic plant treatment (Said *et al*., 2015). Nonetheless, this flaw is outweighed by the numerous advantages this technology offers in wastewater treatment (Kozminska *et al*., 2018; and Syukor *et al*., 2014).

The most important advantage of aquatic plant treatment is that it is a green technology that promotes long-term growth. It uses plant and microbe natural resources, lowers degradation of the environment, safeguards ecosystems, and improves lives and health. Other benefits include the fact that Both organic and inorganic pollutants are effectively treated by aquatic plants, making them suited for the treatment of mixed types of pollutants using multiple mechanisms (Phytoaccumulation, Phytodegradation, Phyto-transformation, Phytovolatilization, and Phytoextraction) to clean up or detoxify pollutants; At low-to-moderate concentrations, it works well on soil that has been contaminated in large quantities and widely scattered pollutants; It can be done in situ while maintaining the soil's texture and structure; It is both ecologically and visually pleasing to the public, with a beautiful view of the surroundings. After cleanup or other development goals, polluted soil can be restored for agricultural use, and treated wastewater can be used for cleaning or landscaping, reducing the negative impact of the ecosystem. Furthermore, because phytotechnology is simple to install and maintain, it is less expensive and less expensive than additional technologies for chemical and physical treatment (Abdullah *et al*., 2020).

Figure 1. depicts the general mechanisms involved in aquatic plant pollution remediation. The treatment procedures for aquatic plants can be split into three categories: (i) pollutant degradation, (ii) suppression, and (iii) extraction, or a mix of these three categories (Santos, and Maranho, 2018; Mohebi and Nazari, 2014).

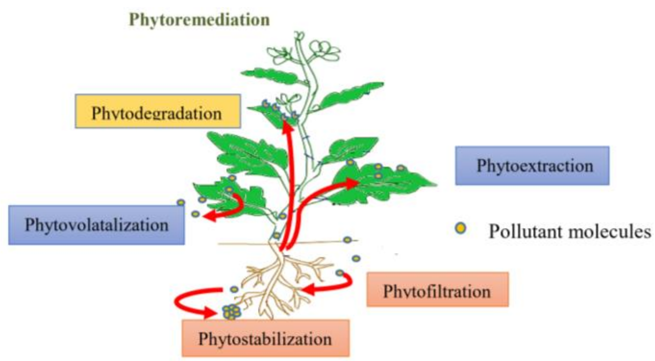

Figure 1. Aquatic plant treatment mechanisms of treat wastewater (Mohebi, and Nazari, 2014).

The processes used by aquatic plants to remove or detoxify contaminants can also be categorized. Extraction of contaminants from groundwater or soil, as well as contamination levels in plant tissue, biotic and abiotic mechanisms that degrade contaminants, volatile pollutant evaporation or transpiration from the plant into the air, and contaminant immobilization in the root zone are examples of these mechanisms (Abdullah *et al*., 2020).

The plant's capability to absorb and transfer large volumes of groundwater in phytoremediation is known as the process of hydraulic monitoring of contaminated sites. This hydraulic control can be managed to prevent horizontal movement and contaminants vertical leaching. During the evaporation and transpiration of water absorbed by the plant, dissolved organic and inorganic compounds enter the plant that may enter other phytoremediation processes. The subsequent uptake and evaporation of volatile compounds through the leave are known as plant volatilization (Figure 2) (Mohebi, and Nazari, 2014). Organic compounds introduced into the plant can be degraded by plant enzymes, which is called plant degradation. Plant accumulation is the absorption and accumulation of minerals in plant tissues.

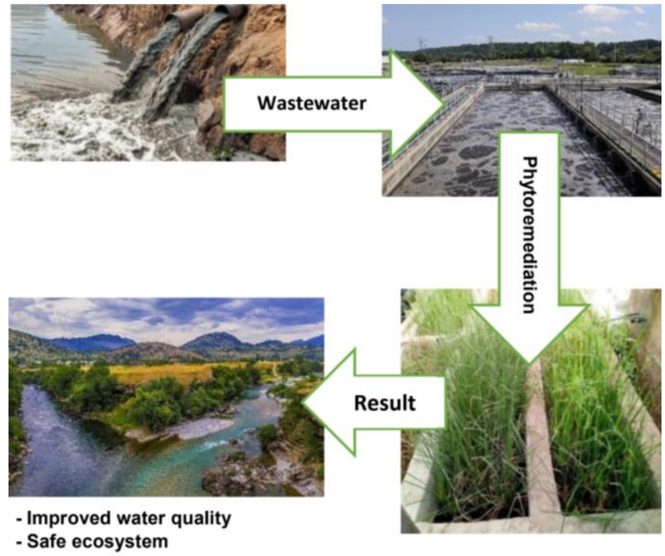

Figure 2. Phytoremediation by plants for refining and absorbing metals in wastewater (Mohebi, and Nazari, 2014).

The combined anaerobic and phytoremediation systems evaluated their potential and efficiency for sanitary wastewater treatment. The results revealed that using a hybrid method of anaerobic and phytoremediation systems resulted in COD and TSS removal rates of up to 80% apiece and turbidity and BOD5 removal rates of up to 90%. Total coliform and intestinal nematode eradication efficiency were 99,999 and 100%, respectively, with the system. According to international effluent irrigation regulations, the treated wastewater quality was adequate (Mohebi, and Nazari, 2014). These are the plants with submerged roots and floating leaves. Several aquatic plants have long been known for their capacity to remove metals from polluted environments: water hyacinth (*Eichhornia crassipes*) (Gunathilakae *et al*., 2018), water ferns (*Salvinia minima*) (Iha, and Bianchini, 2015), duckweeds (*Lemna minor* or *Spirodela intermedia*), (da-Silva *et al*., 2017; Daud *et al*., 2018), water lettuce (*Pistia stratoites*) (Abbas *et al*., 2019), and watercress (*Nasturtium officinale*) (Shi *et al*., 2020). Table 1 outlines the potential of several aquatic plants for phytoremediation of aquatic environments. Figure 3 shows several aquatic plants used for water and wastewater phytoremediation (Mohebi, and Nazari, 2014; Mustafa and Hayder, 2020; Patel and Kanungo, 2012; and Priya and Selvan, 2017).

Water pollution with effluents from industries and heavy metals increases, which has led to increased safety warnings. Lack of contaminant-free water due to industrialization and urbanization raises worries, as are projections of clean water supply depletion in the future years. This has led scientists to study and find available ways to purify water. Detoxifying water using traditional ways is expensive and time-consuming; therefore, scientists have turned to more cost-

Table 1. Different aquatic plants' phytoremediation capabilities (Mohebi and Nazari, 2014)

Aquatic Plant		**Pollutant**	**Wastewater type**
Common Name	**Scientific Name**		
Water hyacinth	*Eichhornia crassipes*	BOD, COD, Fe, Zn, Ni, Oil, grease,....	Industrial wastewater
Water lettuce	*Pistia stratiotes*	Cd, Zn, Ni, Pb, Cu, NO_2^-	Industrial wastewater
Narrow-leaf cat-tail	*Typha angustifolia* L.	BOD, COD, color, TDS	Textile wastewater
Common duckweed	*Lemna minor*	BOT, Cl-, SO_4^{2}-, BOD, COD, TDS, Cu, Ti, Pb	Industrial wastewater
Water spinach	*Ipomeo aquatica*	COD, TDS, NO_2^-, NH_3-N, P, Ni, Pb, Cd	Palm oil mill effluent
Parrot-feather	*Myriophyllum aquaticum*	BOT, Cl-	River water
Coontail	*Ceratophyllum demersum*	N, P	Fish pond wastewater
Floating fern	*Salvinia natans*	BOD, COD, NH_4-N	Raw wastewater
Vetiver	*Vertiveria zizaniodes*	NH_3, NO_2, NH_4, PO_4	Fish pond wastewater
Spiked water-milfoil	*Myriophyllum spicatum*	COD, TN, TP, NH_4-N	Polluted rural river water
Bulrush	*Typha orientalis*	BOD, Na, TOC, turbidity, NO_2^-	Municipal wastewater
Water-thymes	*Hydrilla verticillata*	BOD, COD, TSS, TP	Secondary domestic wastewater

effective alternatives like phytoremediation, which uses particular plants that live in it to filter water, and hydrophytes. Many plants (*Eichhornia crassipes*) have been issued as purifiers of organic matter pollution (Rai, and Panda, 2014). In this way, using plants to reduce pollutants may contribute to their operational applications (Rai, 2015). Also, as a consequence of recent breakthroughs and advances in phytoremediation techniques, the use of aqueous Hyacinth in wastewater treatment has been widely documented, and treatment regimens have been developed (Patel, and Kanungo, 2012).

a) Water hyacinth (*Eichhornia crassipes*)

b) Water lettuce (*Pistia stratiotes*)

c) Water spinach (*Ipomeo Aquatica*)

d) Common reed (*Phragmites australis*)

Figure 3. Some of the aquatic plants utilized for phytoremediation of water and wastewater (Mohebi, and Nazari, 2014).

The percentage of Arsenic in drinking water has caused great concern in many communities worldwide, which has already affected many people. Although different aquatic plants were shown to absorb Arsenic and have been recommended for arsenic phytoremediation, the management, transfer, and burial of these aquatic macrophytes is an important consideration in effectively using the phytoremediation initiative, given the materials available (Raju *et al*., 2015).

***Conclusion*:** Recently, Aquatic plants provide many benefits to humans, with many new applications still to be identified. However, introducing aquatic plant species that become problematic under specific conditions is putting both marine and freshwater environments at risk right now. These plant species are frequently imported from other regions for medicinal or horticultural purposes, but they eventually escape domestication and establish natural populations. Other pollutants, such as hydrocarbons and other hazardous and carcinogenic substances, can be removed from water using these aquatic plants. The application of growth-promoting bacteria that stimulate the growth of rhizosphere plants and the overgrown plants could be another modification that can have the maximum treating effect. Aquatic plants have many applications in wastewater treatment, due to their much lower cost and higher efficiency. Numerous studies have proved Aquatic plants to be sinks for wastewater treatment, and they are also used in the treatment process and to reduce or limit pollutant wastewater. The treated wastewater's quality was acceptable, according to the international effluent standards for irrigation.

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