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Survey of Phragmites australis for Phytoextraction of Cadmium in International Shadegan Wetland

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ABSTRACT

Phytoremediation has been defined as the use of green plants and their associated microorganisms, soil amendments and agronomic technigues to remove, contain or render harmless environmental pollutants. The possible use of green plants to remove organic pollutants and toxic metals from wastewater and contaminated soils is described, with its limitations and advantages [1]. Phytoextraction, the use of pollutant-accumulating plants to remove metals or organics from soil by concentrating them in harvestable plant parts [2]. Metals in the environment are commonly absorbed and concentrated by plants and animals. This can be dangerous to humans if they eat the plants and animals. On the other hand, this characteristic is useful to some environmental restoration projects. After plants absorb metals that contaminate soils, the plants can be harvested and disposed of in a way that removes the absorbed metals from the environment [1]; also Heavy metals are important inorganic pollutants that are entered to aquatic ecosystems by municipal, agricultural and industrial wastewater. Heavy metals can transport and accumulate throughout the food chain. Accumulation of heavy metals in organism's tissues is called biomagnification [3]. These elements are not biodegradable, therefore we have to remove or immobilize them for cleaning up the polluted environment [4]. In this research, macrophytes potential for remediating of Cd by phytoextraction process was investigated. For this research, Phragmites australis and bottom sediment at 3 polluted stations and 1 control station in summer and winter seasons were sampled. Generally 72 macrophyte and 24 bottom sediment samples were taken. Preparing and chemical digestion was preformed according to the standard methods and Cd concentration in samples was measured by using flame atomic absorption spectrophotometery. Then with utilizing Dunkan test and Varians Analysis (%95 precision), bioconcentration of Cd in the organs of studied macrophyte and sediment were compared by statistical tests. Samples analysis results in the summer season showed the average of Cd concentrations in sediments 3.97 (ppm) and roots and stems of Phragmites australis respectively were 2.6 (ppm) and 1.25 (ppm); Also in the winter season average of Cd concentrations in sediments roots and stems of Phragmites australis, respectively 4.25 (ppm), 2.67 (ppm) and 1.17 (ppm) were obtained. The achieved results demonstrated bed sediments of Shadegan International wetland have Cd pollution and Phragmites australis capable for phytoextraction and accumulation of Cd in the macrophyte organs.

Key words: Phragmites australis, Cd, Phytoextraction, International Shadegan Wetland, Iran.

Introduction

The ability of green plants to remove organic pollutants and toxic heavy metals from wastewater and contaminated soils is described, with its limitations and advantages [5]. Sediments that surround and are influenced by plant roots. Phytoremediation has several advantages. It is inexpensive compared to conventional technology and could prove cost effective for contaminated water and sediments [5]. Metals in the environment are commonly absorbed and concentrated by plants and animals, this can be dangerous to humans if they eat the plants and animals. On the other hand, this characteristic is useful to some environmental restoration projects. After plants absorb metals that contaminate soils, the plants can be harvested and disposed of in a way that removes the absorbed metals from the environment [4]. International Shadegan wetland area is 537700 hec that 29600 hec of has been allocated as wild life refuge. Shadegan wetland is locate in the Eastern longitude 48° 50', 48° 17' and Northern latitude 30° 58', 30° 17' in south western of Iran. Urban, mining, agricultural and industrial waste water such as steel industries, oil refinery are threatening factors of the International Shadegan wetland [5].

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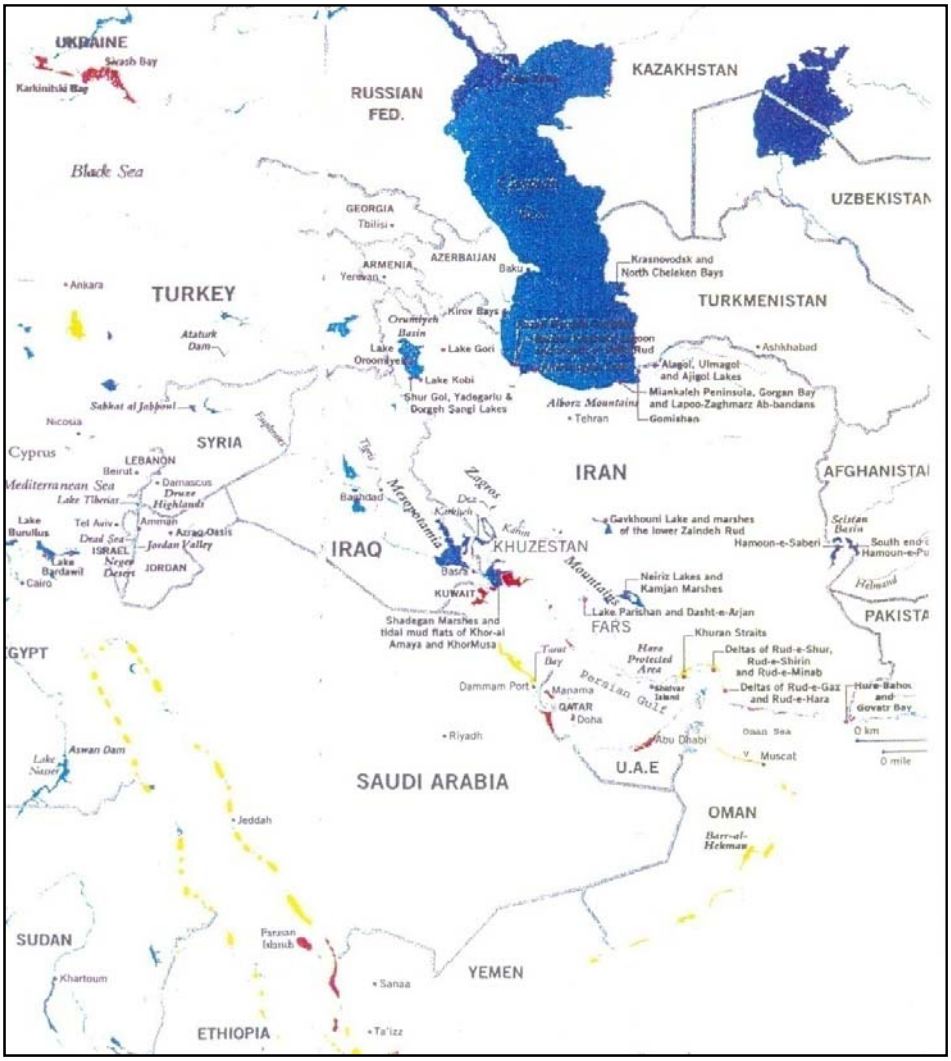

Fig. 1: distribution of Iran wetlands.

Materials and Methods

According to survey of studied area 4 sampling stations based on aggregation and distribution of Phragmites australis and entrance of pollutants sources were selected. Coordinate of selected stations have been presented in follow table:

Table 1: characteristics of site position studied stations.

Altitude (m)	Longitude	Latitude	Station Name	Station Number
6	0258558	3400324	Shoger site (Blank)	1
5	0265468	3397181	Rogbeh	2
1	0283444	3383003	Khoor doragh	3
6	0298001	3421517	Mansoreh	4

Bed sediments were sampled by van vin grab and studied macrophyte were taken manually, then preparation and chemical digestion of samples for injecting to flame atomic absorption spectrophotometery according to standard methods was done. At first macrophyte samples by urban treated water and then with distilled water were washed carefully. For determining of Cd concentrations in roots, stems and leaves of Phragmites australis, The organs were separated and put them separately in Aven 105 within 48 hr, then organs were grinded and powdered by an electric mill separately, Also for drying of sediment samples, they were put in Aven 105 within 48 hr and by using the china mortar were homogenized and fine, then for separating of particles diameter less 63 (micrometer) in sediment samples was used sieve 230. Then 1 g_r of each sediment and organs samples

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were taken, and we were put them on PE dishes on Benmary Aqueous bath, Also for chemical digestion process of sediment and macrophyte samples, Choloridric acid 5 ml and Nitric acid 15 ml added. Before beginning of chemical digestion process, 7 ml Hydrofluoric acid was added to sediment samples [6]. Digested samples was filtered by wattman$_{45}$ filtration paper, and distilled water was added digested samples to 30 ml, then for determining of concentrations of Cd in samples, they were injected to calibrated Flame atomic absorption spectrophotometery [6,7]. All of utilized dishes in this study, before preparating and chemical digestion, were washed by Nitric acid, then were washed by distilled water and were dried carefully [6]. To determing of Cd concentrations in all of samples flame atomic absorption spectrophotometery Philips 9400 PU model was used, Also for each group of samples a blank (control) and with the other samples were analyzed and the results were reported zero. All of chemicals were analytical regent [8].

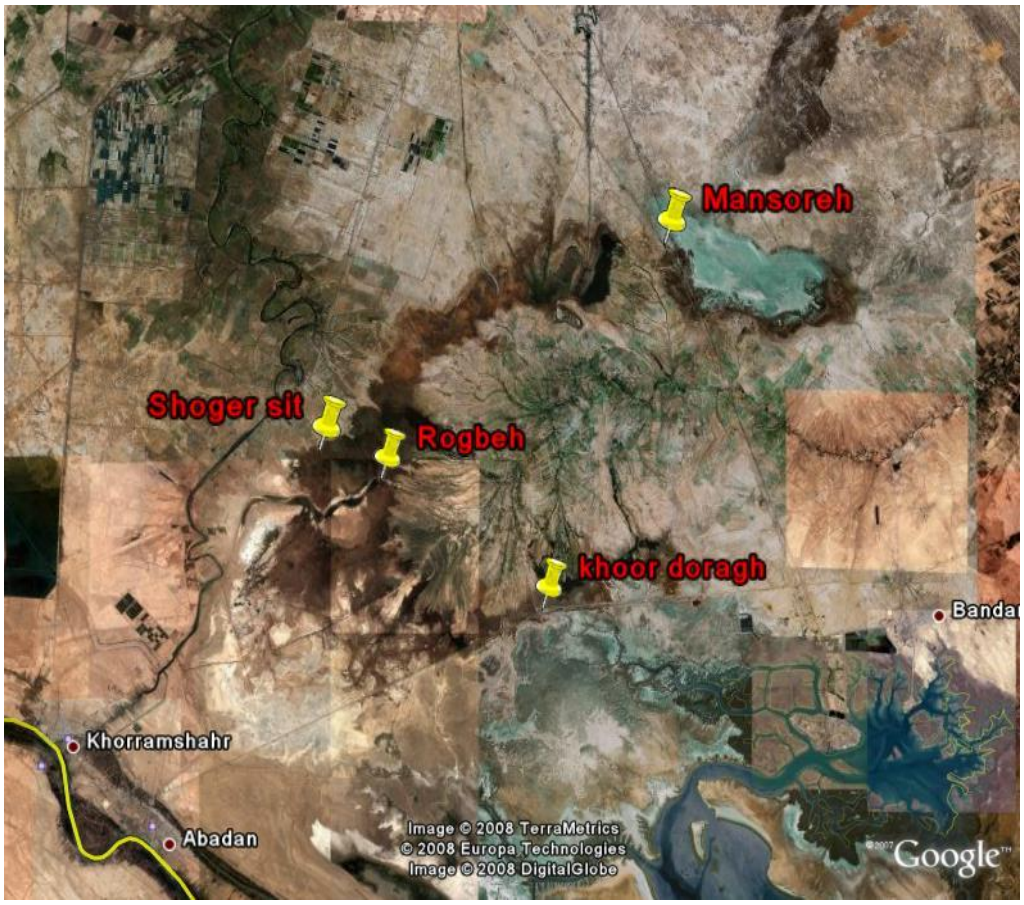

Fig. 2: satellite imaging of site position studied stations.

Analysis of Results:

Instrumental and statistical analyses of sediment samples and Phragmites australis, At 4 station have been presented in diagrams.

Average Cd concentration in sediment, root and stem of Phragmites australis, in summer (natal season) respectively were determined 3.97 (ppm), 2.6 (ppm) and 1.25 (ppm), Also average Cd concentrations in sediment, root and stem in winter (propinquity season) were defined respectively 4.25 (ppm), 2.67 (ppm) and 1.17 (ppm). Maximum of average concentration of Cd were measured in bed sediment equal 4.25 (ppm), then root organ had maximum average concentration of Cd uptake, equal 2.67 (ppm).

Discussion and Deduction:

Results of sediment instrumental analysis demonstrated that maximum Cd concentration of sediment was found in Khoor Douragh. In order to impressing of oil refinery, Abadan power plant, oil leakage from oil transmission pipeline and vicinity to Persian Gulf and in order to Cd is the index of oil pollution, we expected concentration of Cd in Khoor Douragh station sediments would be more than the other stations. Generally maximum bioaccumulation

of Cd in root organ of Phragmites australis, was found. Because of studied macrophyte has perennial roots in sediments but stems and leaves are not perennial root organ had more average concentration of Cd than the other organs. Instrumental and statistical result demonstrated that bed sediments of Shadegan wetland have Cd pollution. Also this survey showed that Phragmites australis is capable to absorption and accumulating of Cd in organs. Therefore Phragmites australis can utilize for remediating of Cd in contaminated soil and water.

Maximum absorption of Cd concentration were observed in winter (propinquity season).

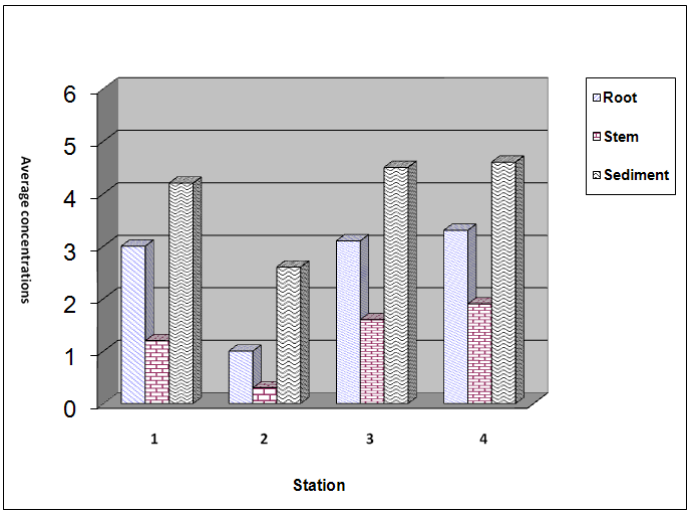

Fig. 3: average concentrations of Cd in sediment and organs in summer season.

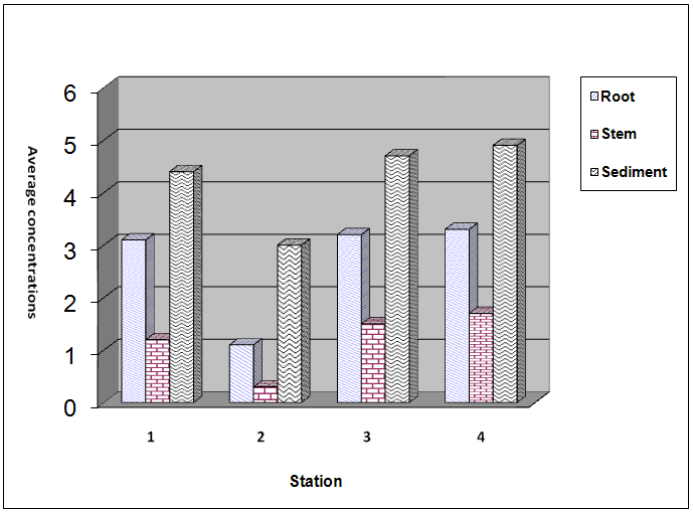

Fig. 4: average concentrations of Cd in sediment and organs in winter season.

Arrival:

1. Utilize of modern and appropriate technologies and methods with minimum pollution in the industry and agriculture departments.
2. Environmental management performance for decreasing entrance of urban, agricultural and industrial wastewater.
3. Optimization and amendment of Phytoremediation mechanisms and appropriate disposal management of polluted plant biomass.
4. Survey of fauna potential for bioremediation of heavy metals in international shadegan wetland
5. Entrance reduction of municipal, agricultural and industrial waste water, to Shadegan wetland.
6. Constructing of artificial wetlands that encompass Phragmites australis, as before influxing of waste water to Shadegan wetland, discharge to constructed wetland and then after decreasing of Cd to maximum permissible concentration.

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