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Phytoremedation of Heavy and Trace Elements in Heglieg oilfield by Some Sudanese Plants

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Abstract: Heglieg oil field is located in the high wood land savanna zone in Western Kordofan State. The method used for the determination of elements was the atomic absorption (Perkin, 1994). One g of air dried plant leaves from: *Acaia seyal. Khaya senegalensis*, *Eucalyptus camaldulensis*, *Ophiuros exaltatus*, sieved plants samples were placed into a furnace for 4 hours for dry ashing. The ash was kept in an Erlenmeyer flask extracting solution and 5ml (1M HCl) were added and the mixture was then placed in a filter paper into a 50- ml with extracting solution.
The results showed that concentrations Ca, Mg in Heglieg oil field were high, and it were significantly different from control plants. Similarly concentrate K, Na, Zn, Fe, Cu and Mn concentrations in Heglieg oil field were low, and were significantly different from control, while Cr, Co, Cd and Pb were not detected.

Key words: Phytoremedation, Heavy and Trace Elements, Heglieg oilfield

1. Introduction

Phytoremediation (from Ancient Greek φυτο *(phyto)*, meaning "plant", and Latin *remedium*, meaning "restoring balance") refers to the technologies that use living plant to clean up soil, air, and water contaminated with hazardous chemicals (Reichenauer, 2008).

Phytoremediation is a cost-effective plant-based approach of remediation that takes advantage of the ability of plants to concentrate elements and compounds from the environment and to metabolize various molecules in their tissues. It refers to the natural ability of certain plants called hyper accumulators to bioaccumulate, degrade, or render harmless contaminants in soils, water, or air. Toxic heavy metals and organic pollutants are the major targets for phytoremediation.

Knowledge of the physiological and molecular mechanisms of phytoremediation began to emerge in recent years together with biological and engineering strategies designed to optimize and improve phytoremediation. In addition, several field trials confirmed the feasibility of using plants for environmental cleanup (Salt, 1998).
Objectives:

1. To study phytoremedation of elements in Heglieg oil field.
2. To investigate the tolerance Sudanese plants for produced water at Heglieg oil filed.

Study area: Hegleig oil field

This study landscape is located in the high wood land savanna zone in Western Kordofan State latitude 9.5958N, 9.99944°N longitude 29.23E, 29.39 E The rainy season begins in mid-May. Rainfall annual average in

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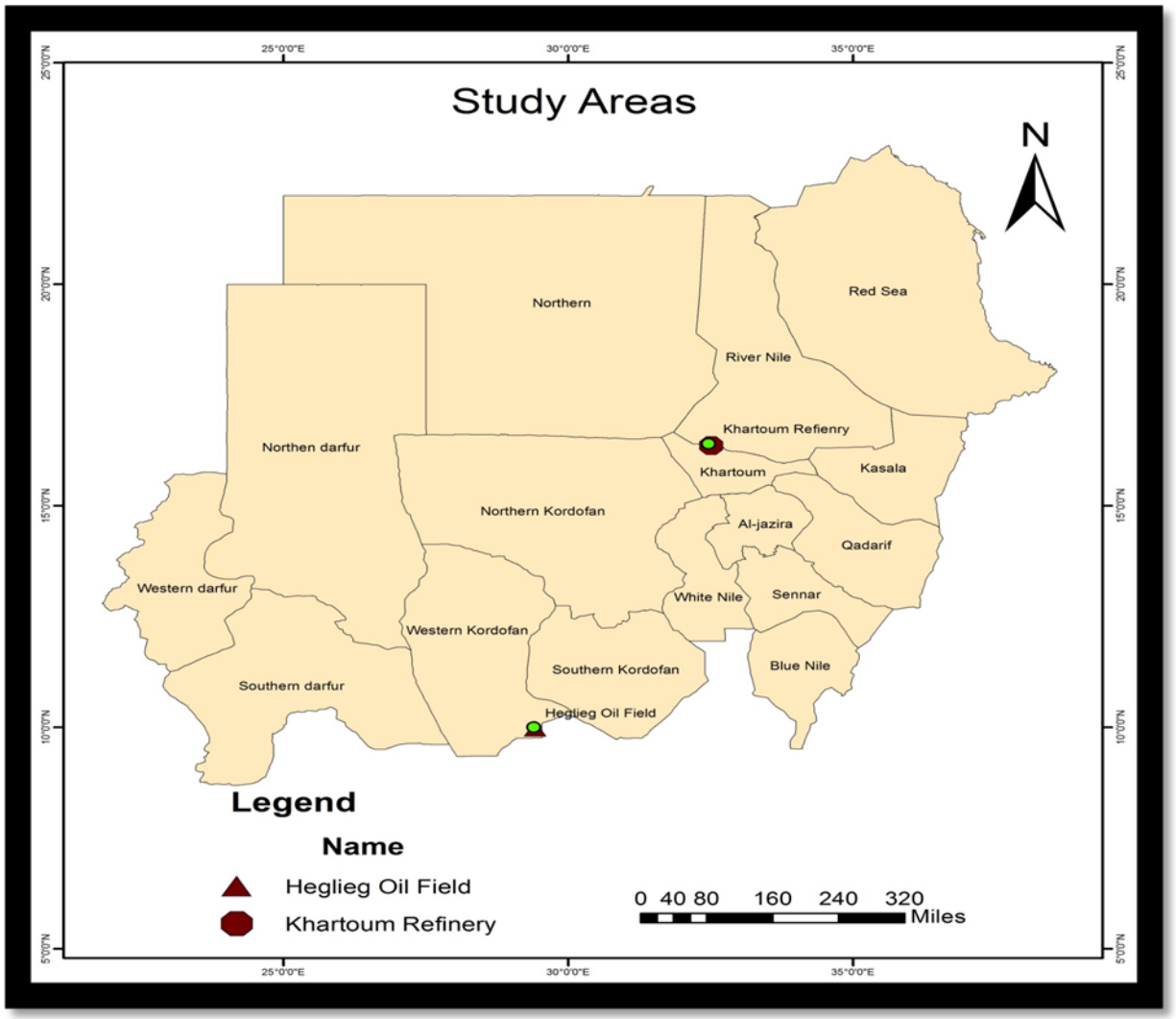
the area is 570-800 mm, the annual maximum temperature average is 28.0ºC and the minimum temperature is 18ºC.

Soil

The soil of the area are homogenous dark grey cracking heavy clays.

Natural Vegetation

According to White (1991) the area is located in the zone of Grassland and wooded grassland on Pleistocene clay. The natural vegetation of Heglieg oil field area and its surroundings is composed of dense woody diversified ground cover. It is part of *Acacia* tall grass Savannah community of the broad classification of the major vegetation zone of the Sudan. Normally in this biome two communities alternate: the *Acacia seyal* & *Balanites aegyptiaca* community followed by tall grassland. The herbaceous cover was typified by *Rottoebellia exaltata*, *Brachioris obtiusiflora* and *Setaria verticillata* tall grasses (Andrews, 1949); (Harrison and Jackson, 1958).



Heglieg treated water Bioremediation system:

The system consists of a series of 6 lagoons, 6 reed beds and 6 small canals. On exiting the reed bed the treated water is fed into a large forest area.

2. Materials and Methods

The plant samples were collected from Heglieg oil field from,6 species grown at Heglieg oil field.

Determination of elements composition of plant leaves:

The method used for the determination of elements was the atomic absorption (Perkin, 1994).

One g of air dried plant leaves and sieved plants samples were placed into a furnace for 4 hours for dry ashing. The ash was kept in an Erlenmeyer flask extracting solution and 5ml (1M HCl) were added and the mixture was then placed in a filter paper into a 50- ml with extracting solution.

Table (1) Plant sampling at Heglieg oil field

No	Plants species	
1	*Acaia seyal*	Treatment
2	*A. seyal*	Control
3	*Khaya senegalensis*	Treatment
4	*Eucalyptus camaldulensis*	Treatment
5	*Ophiuros exaltatus*	Control
6	*O. exaltatus*	Treatment

3. Results and Discussions

The results showed that concentrations Ca, Mg in Heglieg oil field were high, and it were significantly different from control plants. Similarly concentrate K, Na, Zn, Fe, Cu and Mn concentrations in Heglieg oil field were low, and were significantly different from control, while Cr, Co, Cd and Pb were not detected.

Table (2). Minerals concentrations in plants irrigated with treated water plus rain versus the control (rainfed) in Hegleig Oil field

Species	Minerals concentrations (mg.l)							
	Ca	K	Zn	Fe	Cu	Na	Mn	Mg
Acaia seyal(T)	30.817 A	1.3200 A	0.2313 B	0.7597 A	0.1913 A	00.941 E	0.8087 ABC	56.5333 A
Acaia seyal (C)	31.120 A	1.2910 B	0.3707 AB	0.7923 A	0. 2493 A	01.880 B	1.3700 A	56.3100 A
Khaya senegalensis (T)	21.390 B	0.9280 C	0.2223 B	0.2893 B	0.3230 A	00.958 E	1.0877 AB	55.2400 B
Eucalyptus camaldulensis (T)	07.413 D	7.0000 A	0.2723 AB	0.2737 B	0.1247 A	10.777 A	0.6027 BC	55.4330 B
Ophiuros exaltatus (C)	16.233 C	0.6563 D	0.3207 AB	0.3063 B	0.2723 A	01.541 C	1.4093 A	56.2230 A
Ophiuros exaltatus (T)	04.276 D	0.9133 C	0.6533 A	0.0877C	0.2170 A	01.326 D	0.1450 C	55.3800 B
P	≤ 0. 6662	≤ 0. 333	≤ 0.0.270	≤ 0.0643	≤ 0.8800	≤ 0.1633	≤ 0.0003	≤ 0.0003
SE	± 4.11	± 2.30	± 0.826	± 0.0130	± 0.1181	± 0.1060	± 0.1420	± 0.1655
CV	= 3. 75	= 2.30	= 41.45	= 5.37	= 89.05	= 1.00	= 27.21	= 0.51

A. seyal: accumulated significantly more in K with treated water than control and got rid partially of Zn and Na by the effect of water.

K. senegalensis and E. camaldulense witch are planted in the treated area showed high Cu concentration both in accumulated significantly more Zn, Mn, Fe and Ca. and lost significantly K and Na. E. accumulated most element and lost Ca.

O. exaltus accumulated K, Fe and lost Ca, Fe and Na.

Plant species of Heglieg oil field (HOF) in this study in different and belong to different species and families, and with different ages, in addition to some native species. So they vary in their characteristics in response to their phytoaccumulation of metals,

Best plant species for accumulation of Ca were HOF were *Acacia seyal* Delile treatment and *Khaya senegalensis*. Best plant species for accumulation of Zn in HOF was *O exaltus* L control. Best plant species for accumulation of K in HOF was *Eucalyptus camaldulensis* treatment. The best plant species for accumulation of Fe in HOF were *Acacia seyal* Delile treatment. The best plant species for accumulation of Cu in HOF was *Khaya senegalensis* treatment. Best plant species for accumulation of Na in HOF was and *Ophiuros exaltatus*. Best plant species for accumulation of Mn in HOF is *Ophiuros exaltatus* control. The best plant species for accumulation of Mg in HOF were *Acacia seyal* treatment and *Ophiuros exaltatus* control.

Generally, the use of phytoremediation is limited to sites with lower contaminant concentrations and contamination in shallow soils, streams, and groundwater. However, researchers are finding that the use of trees (rather than smaller plants) allows them to treat deeper contamination because tree roots penetrate more deeply into the ground.

The success of phytoremediation may be seasonal, depending on location. Other climatic factors will also influence its effectiveness.

The success of remediation depends in establishing a selected plant community. Introducing new plant species can have widespread ecological ramifications. It should be studied beforehand and monitored. Additionally, the establishment of the plants may require several seasons of irrigation.

4. Conclusions

1. The treated water as well as depositing some elements it can also leach out other from plants.
2. It is better to plant mixture of species than one species.

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