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Soil Quality Evaluation (For Heavy Metals) in Coastal Region of PSR Nellore Dist, Andhra Pradesh, India

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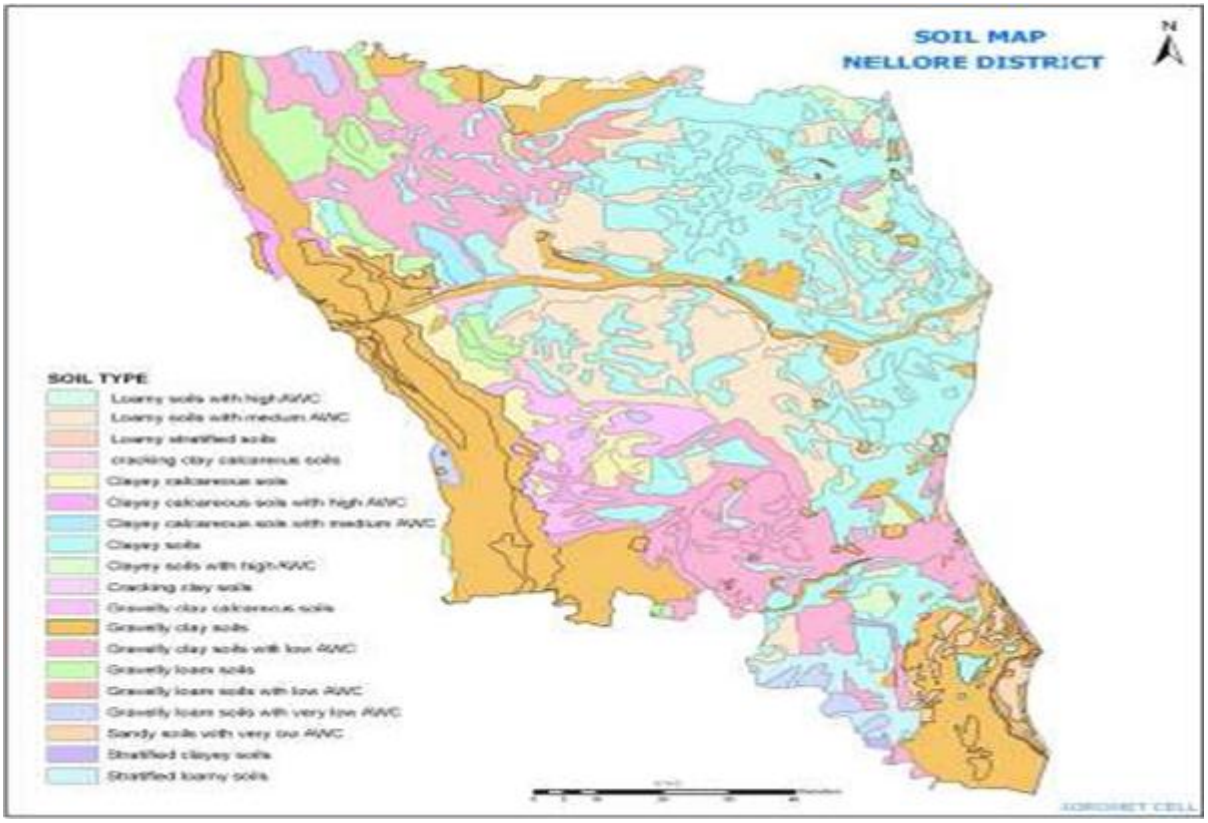
Abstract: ***PSR Nellore district is famous for agricultural and Aquaculture activities in Andhra Pradesh. The study has been conducted in coastal region of Nellore district to understand the contamination levels of heavy metals in both agricultural land soil and aquaculture land soils. For this Study 20 soil samples were collected in 12 mandals of Coastal Region of PSR Nellore Dist, A.P. India in March 2019. The soil sampling was performed in-line to USEPA soil sampling guidelines. Each soil samples were collected in three different depths (30centimeter depth, 60 centimeters depth and 90 centimeters depth) from surface level and made the grab sample and made homogeneous sample. The homogeneous sample is used for the determination of heavy metals. The concentration of heavy metals was measured by using Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES) & ICP-MS techniques. The concentration levels are summarized in Results and discussion.***

Keywords: PSR Nellore District- Coastal Region-Heavy metals contamination – Soils – ICP-OES

1. Introduction

India is one of the largest producers of agriculture and aquaculture in the World. Andhra Pradesh economy is mainly based on agriculture and livestock[1] and aquaculture activities. PSR Nellore district is one of the most populous districts in Andhra Pradesh. Nellore is one of the famous district for Agriculture and Aquaculture activities. Yearly more than 86000 tons of sea food is exporting from Krishna Patnam Port. The Soil is most important natural resource and the soil will play key role in agriculture and Aquaculture activities. Soil is composed of mineral constituents, organic matter (humus), living organisms, air, and water, and it regulates the natural cycles of these components [9,10] More than 20 crops varieties are cultivating at Nellore district due to the different varieties of soils nature available in Nellore district. Different varieties of soils are given in below picture.[2]



Heavy metals are the elements with a density greater than 5 g / cm3. They can be found in air, water and soil. These metals often interfere with the normal course of metabolic processes even in trace amounts, causing several diseases

and act by accumulation effects, with an exception of low tolerable doses. Such metals often have a toxic effect, so their presence in the aquatic ecosystem pocess risks to human health and causes harmful effects to living organisms [6]. Heavy metals occur naturally in soils, which are formed by geological processes, such as alteration and erosion of the geological underground materials [11,12]

In the soil migration of heavy metals takes place due to mass transfer, which involves water carrier, diffusion. Migration of metals in soils depends on various properties of soil [7]. Soil pollution by heavy metals has serious health implication especially with regards to crops/vegetables grown on such soils [13,14]. Heavy metals occupy a special position in soil chemistry because they play very important physiological roles in nature [14,15].

Study of heavy metals in soil is very important because of soil is interlinked with ground water surface water, crop and Aquaculture. If the soils are contaminated with heavy metals or higher concentrations of heavy metals in soil there may be a chance to bioaccumulation of these heavy metals into crop that may be effect on the human health. Or there may be a chance to leach of heavy metals into water bodies.

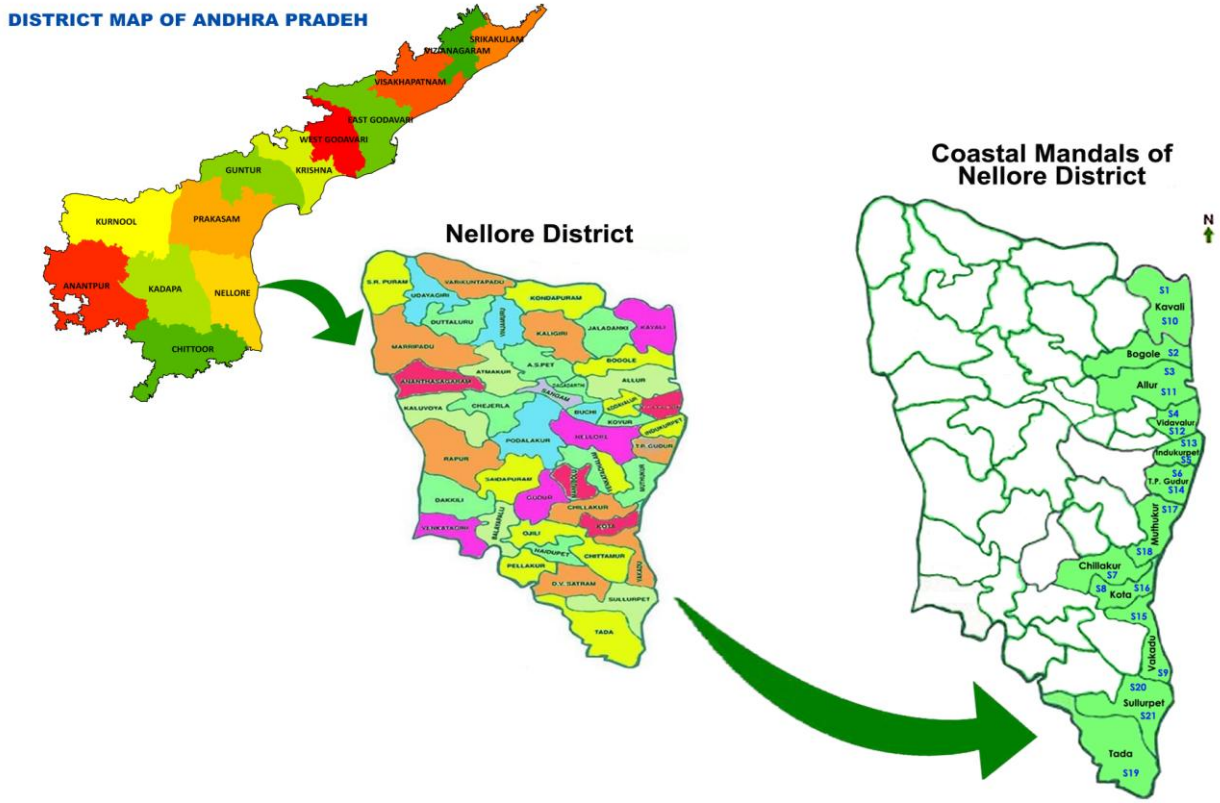
The metals are classified as "heavy metals" if in their standard state they have a specific gravity of more than 5 g/cm3. There are known sixty heavy metals. Heavy metals get accumulated in time in soils and plants and could have a negative influence on physiological activities of plants (e.g. photosynthesis, gaseous exchange, and nutrient absorption), determining the reductions in plant growth, dry matter accumulation and yield[3,4] In small concentrations, the traces of the heavy metals in plants or animals are not toxic[5] Lead, cadmium and mercury are exceptions; they are toxic even in very low concentrations [Galas-Gorchev, H. Dietary Intake of Pesticide Residues: Cadmium, Mercury and Lead. *Food Add.Cont.* **1991**, *8*, 793-806].

Heavy metals can be found generally at trac e levels in soil and vegetation, and living organisms feel the need for micro-elements of these metals. However, these have a toxic effect on organisms at high content levels. Heavy metal toxicity has an inhibitory effect on plant growth, enzymatic activity, stoma function, photo-synthesis activity and accumulation of other nutrient elements, and also damages the root system[8]

There are several studies on heavy metals determination in water, soil and air quality monitoring due to, industrial and domestic sectors to know the environmental pollution. Hence, the aim of the present study is to understand the levels of heavy metals in soils of coastal areas of PSR Nellore district, Andhra Pradesh, India.

2. Study Location

Study locations were identified in the below map.



Sampling / Sample collection

All soil samples were collected from different areas of Coastal areas of PSR Nellore district as per USEPA soil sampling guidelines. . Each sample was collected in three depths (surface, 30centimeters depth, 60 centimeters depth and 90 centimeters depth) and mixed thoroughly. The mixed sample is then oven-dried at 70°C for 48 h before and made fine particles using mortar with pestle.

Sample Preparation / Sample Digestion Procedure

These homogeneous samples are used for metal digestion. 1.0 g finely grinded and dried soil samples were taken in cleaned microwave digestion vessel and added 7 mL of

concentrated HNO_3, 1 mL of HCl and 2 mL of Hydrogen Peroxide solutions. Closed the lid of vessel and digested by using microwave digestion system. After completion of digestion, the system was cooled and removed the vessels from Microwave digestion. The samples were filtered by using watman no. 42 filter paper and collected the filtrate in 50 mL Volumetric flash and made the final volume up to 50 mL by suing diluents as 2 % Nitric acid solution.

Principle and sample analysis by ICP

Radio frequency induction of Argon takes place and generates a high temperature nearly 6000ºK. Sample is introduced into mixing chamber and the sample is mixed with argon gas, sample is converted in to aerosol form. Only fine droplets or aerosol can enter in to the plasma temperature. At that temperature interferences of other element can eliminate. Each element has its characteristic wavelength. At that characteristic wavelength the intensity of each element can be measured.

Before doing the analysis external calibration can be made by using five linear multi element standards were used which is traceable to NIST. We observed good linear correlation coefficient for all metals (>0.995). QC check results were observed within the satisfactory levels.

Operating conditions of ICP-OES

Power	: 1200 watts
Nebulizer Flow	: 0.8 L / min
Auxiliary Flow	: 1.2 L/ min
Viewing Height	: 10

3. Results and Discussion

Twenty one soil samples were collected in 12 mandals of coastal areas of Nellore district and analyzed for Pb, Cd, As, Co, Fe, Cr, Cu and Hg by ICP-OES. Sampling location details and the heavy metals concentration levels are summarized in Table -1 and results were discussed below.

Location Name	Cd	Co	Cr	Cu	Fe	Hg	As	Mn	Ni	Pb	Zn
	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Soil sample -1(Annemadugu-Aqua-KavaliMandal)	0.200	1.862	30.500	10.499	6738.4	<0.050	0.105	165.091	15.539	15.883	15.062
Soil sample -2(Vulavapalla-Paddy-BogoluMandal)	0.073	0.000	52.122	30.347	19124.2	<0.050	0.145	591.290	29.892	32.243	33.223
Soil sample -3(Allur-Aqua-AllurMandal)	0.218	9.543	26.275	8.265	6209.4	<0.050	0.145	230.000	11.000	22.250	19.200
Soil sample -4(Parlapalli-Aqua-VidavalurMandal)	0.278	14.330	23.673	11.948	7310.7	<0.050	0.095	421.725	15.848	19.527	20.059
Soil sample -5(Pallepadu-Paddy-IndukurupetMandal)	0.193	10.691	23.774	9.733	6691.4	<0.050	0.090	152.523	13.062	17.327	32.254
Soil sample -6(Narukuru-Aqua-TP gudurMandal)	0.208	0.000	43.042	22.012	13534.2	<0.050	0.140	267.746	28.823	46.700	31.035
Soil sample -7(Varagali-Paddy-ChillakurMandal)	0.058	0.000	22.020	8.687	20144.1	<0.050	0.110	62.279	7.331	40.330	22.453
Soil sample -8(Kadivedu-Paddy-KotaMandal)	0.153	0.000	39.584	17.968	12148.9	<0.050	0.095	305.780	18.091	40.630	27.546
Soil sample -9(Vakadu-Paddy-VakaduMandal)	0.273	0.000	33.855	13.513	9963.5	<0.050	0.200	285.005	19.436	27.191	23.190
Soil sample -10(Kattakinda palem-Paddy-KavaliMandal)	0.067	0.000	41.174	15.328	13942.6	<0.050	0.145	596.200	28.279	23.088	23.774
Soil sample -11(Iskapalli-Paddy-AllurMandal)	0.240	0.000	36.628	15.847	10515.1	<0.050	0.085	493.085	20.815	78.195	29.325
Soil sample -12(Parlapalli_Paddy-)	0.195	9.782	55.482	7.133	6737.7	<0.050	0.095	448.049	10.585	21.302	13.818
Soil sample -13(Pallepadu-Aqua-IndukurupetaMandal)	0.130	0.000	44.420	22.596	14495.6	<0.050	0.120	369.920	25.710	36.080	36.110
Soil sample-14(Narukuru-Paddy-TPgudurMandal)	0.191	0.000	27.605	14.424	9378.3	<0.050	0.110	227.677	17.476	54.577	30.160
Soil sample -15(Thupilipalem-Aqua-Vakadu mandal)	0.178	10.681	24.445	10.226	6870.2	<0.050	0.145	155.074	13.167	18.071	31.047
Soil sample -16(Balireddypalem-Aqua-Kota Mandal)	0.176	9.620	29.460	9.551	6866.4	<0.050	0.055	250.798	12.157	21.745	18.732
Soil sample -17(Malluru-Paddy-Muthukur Mandal)	0.198	9.983	26.189	13.697	8205.9	<0.050	0.145	470.562	16.737	25.578	23.092
Soil sample -18(KrishnaPatnamPort-Paddy-Muthukur Mandal)	0.302	5.407	48.071	24.727	15026.3	0.138	0.220	294.101	30.382	78.92	35.448
Soil sample -19(Kadalur-Paddy-Tada Mandal)	0.272	6.271	38.293	14.057	10988.1	<0.050	0.115	309.028	20.476	28.890	25.635
Soil sample -20(Sriharikota-Paddy-SullurpetaMandal)	0.180	0.000	47.628	23.574	15403.9	<0.050	0.111	379.364	26.730	35.456	36.786
Soil sample -21(Sarvareddy kandriga-paddy-SullurpetaMandal	0.095	0.000	47.184	17.071	15101.9	<0.050	0.095	645.630	28.243	26.546	26.672
Minimum	0.058	0.000	22.020	7.133	6209.4	<0.050	0.055	62.279	7.331	15.883	13.818
Maximum	0.302	14.330	55.482	30.347	20144.1	0.132	0.220	645.630	30.382	78.195	36.786

Lead: Lead concentration is ranging from 15.88 mg/kg to 78.19 mg/kg. The highest lead concentration observed in S-18 (KrishnaPatnamPort-Paddy-Muthukur Mandal) and lowest concentration observed in S-1(Annemadugu-Aqua-KavaliMandal).

Cadmium: Cadmium concentration is ranging from 0.058 mg/kg to 0.302 mg/kg. The highest Cadmium concentration observed in S-18 (krishnapatnam port) and lowest concentration observed in S-7 (Varagali-Paddy-Chillakur Mandal)

Arsenic: Arsenic concentration is ranging from 0.055 mg/kg to 0.220 mg/kg. The highest Arsenic concentration observed in Location S-18(KrishnaPatnamPort-Paddy-Muthukur Mandal) and lowest concentration observed in S-16 (Balireddypalem-Aqua-Kota Mandal).

Mercury: Mercury concentration is ranging from 0.049 mg/kg to 0.235mg/kg. The highest Mercury concentration observed in S-14 (Narukuru-Paddy-TP gudur Mandal)- and lowest concentration observed in S-6(Narukuru-Aqua-TP gudurMandal)

Cobalt: Cobalt concentration is ranging from not detected to 14.33 mg/kg. The highest Cobalt concentration observed in S-4(Parlapalli-Aqua-VidavalurMandal).

Chromium: Chromium concentration is ranging from 22.0 mg/kg to 55.48 mg/kg. The highest Chromium concentration observed in S-12(Parlapalli_Paddy-) and lowest concentration observed in S-7(Varagali-Paddy-ChillakurMandal).

Copper: Copper concentration is ranging from 7.133 mg/kg to 30.35 mg/kg. The highest Copper concentration observed in S-2(Vulavapalla-Paddy-BogoluMandal) and lowest concentration observed in S-12(Parlapalli_Paddy-)

Nickel: Nickel concentration is ranging from 7.33 mg/kg to 30.38 mg/kg. The highest Nickel concentration observed in S-18(KrishnaPatnamPort-Paddy-Muthukur Mandal) and lowest concentration observed in S-7(Varagali-Paddy-ChillakurMandal).

Manganese: Manganese concentration is ranging from 62.279 mg/kg to 645.63 mg/kg. The highest Manganese concentration observed in S-21(Sarvareddy kandriga-paddy-SullurpetaMandal and lowest concentration observed in S-7(Varagali-Paddy-ChillakurMandal).

Iron: Iron concentration is ranging from 6209 mg/kg to 20144.1 mg/kg. The highest Iron concentration observed in S-7(Varagali-Paddy-ChillakurMandal) and lowest concentration observed in S -3(Allur-Aqua-AllurMandal).

Zinc: Zinc concentration is ranging from 13.818 mg/kg to 36.786 mg/kg. The highest Zinc concentration observed in S -20 (Sriharikota-Paddy-SullurpetaMandal) and lowest concentration observed in S-12(Parlapalli_Paddy).

4. Conclusion

In this study we made an attempt to know the heavy metals concentrations of Soils in Coastal areas of PSR Nellore District, A.P. India. Based on above study Arsenic, Cadmium and Lead contents were observed highest concentration in Near to Krishnapatnam port then compared to other locations. Mercury also slightly identified in near to Krishnapatnam port area. Lead, cadmium, Arsenic and Mercury are most important heavy metals, which may cause highly impact on human health even in lower concentrations also. There are several thermal power plants and other industries located near to Krishnapatnam port area. So due to this reason this heavy metals concentrations identified higher concentration levels in this port area. It is recommended to increase the Air monitoring frequency and mitigation measures at Krishnapatnam port area to control the heavy metal pollution.

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