International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 5, 2025
https://www.theaspd.com/ijes.php

Effect Of Crude Oil Drilling On Agricultural Products In Selected Areas Of Sivasagar District, Assam

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Abstract

Oil spills pose a serious risk to the environment particularly in developed and industrialized nations. In addition to affecting the fertility of the soil and harming agricultural crops it also deteriorates the quality of the surface soil and surface water around oil drilling areas. Present study investigates the presence of the levels of some trace elements in certain agricultural products such as lead in potato, cadmium in raw papaya, copper in tomato, cobalt in raw banana, nickel in brinjal, chromium in lime, iron in leafy vegetables, manganese in carrot and zinc present in ladies finger. High concentrations of some trace metals in soil may promote plant uptake, which could result in bioaccumulation in plants and animals that depend on them, which could cause dangerous food chain interaction.

Keywords: oil drilling, soil pollution, heavy metal contamination, agricultural products.

1. Introduction

Petroleum, often known as crude oil, is one of the most significant and common sources of energy used by humanity for a variety of uses. Crude oil is primarily used for power generation and transportation, and it also acts as a raw ingredient for a number of petroleum products. (Prasad & Katiyar, 2010). The crude oil has carbon content between 84 - 86%, hydrogen content between 10-14%, and only traces levels of sulphur, nitrogen, and oxygen. However, the most prevalent heavy metals discovered in crude oil are Cu, Zn, Cd, Mn, Fe, V and Ni (Mukut & Arundhuti, 2012). Additionally, during the refinement of crude oil, enormous amounts of dangerous pollutants, such as persistent contaminants such as PAHs and non-biodegradable heavy metals as Cr, V, Ni, Pb, Co and Cd are released. The majority of heavy metals are poisonous even in small amounts (Menon et al., 2001). Oil production is increasing in areas where people live, work, and play; these activities may have an effect on public health. Continuous and unregulated use inhibits the ecosystem from regenerating the depleted biological resources and restoring the devastated areas (Gorlenko et al., 2020). Petroleum products contain toxic elements such as polyaromatic hydrocarbons, benzene, toluene and polycyclic aromatic hydrocarbons which have negative health effects on people who breathe them in.

Exploration and production of natural gas and crude oil, transportation, refining, and marketing and distribution comprise the four primary sectors of petroleum industry. The focus of the current study is on exploration and production activities. Because of their negative impacts, oil spills, drilling mud and fluid, formation waters, and effluent discharge are all concerning. The chemical composition, content, and characteristics of the component fractions, as well as the mode, amount, and duration of exposure, all influence how hazardous and deadly petroleum hydrocarbons are generally (Ossai et al., 2020). Oil spills pose a serious threat to the environment, especially in both developed and developing nations. These hazards disrupt soil microorganisms, lower soil fertility, and damage plants (Ahmad et al., 2015).

Environmental pollution caused by oil spills and petroleum products is a major concern worldwide, but is especially acute in Sivasagar district of Assam. Along with solid minerals, fish from the rivers, enormous plants, tea plantations, and a variety of creatures from the forest vegetation, this location is also rich in solid minerals. Long-term oil drilling operations that periodically result in spills and gas flares have turned once-fertile farmlands into deserts, with the extinction of plants, animals, and fish due to environmental toxins from petroleum.

Concern over the toxicity of heavy metals, which are important environmental pollutants, is growing for nutritional, ecological, evolutionary, and environmental reasons. Any metallic element with a relatively high density that is toxic or dangerous even in trace levels is considered a heavy metal. According to Hawkes (2019), the atomic density of heavy metals or metalloids is higher than 4 g/cm^3, which is higher than that of water. Heavy metals include elements from the Pb, Cd, Ni, Co, Fe, Zn, Cr, As, Ag, and Pt groups.

Crude oil pollution has a major impact on the morphological and physiological traits of plants, which ultimately reduces plant productivity. Crop production is put at risk and is negatively impacted by oil exploration activities that lead to hydrocarbon-contaminated soil. Unless they are appropriately repaired, have an influence on the bio-economic system by making land unfit for cultivation and other economic activity. India has a large population, and as agriculture is the country's primary economic engine, the government and the private parties in charge of its oil industry must take swift action to resolve this problem (Ogbo et al., 2009; Omosun et al., 2008). Therefore, higher soil concentrations of Ni, Cu, and Pb may make it easier for plants to absorb these elements, which could result in bioaccumulation by plants and animals that depend on them for survival, which could all have dangerous effects up the food chain (Duffus, 1980).

Plant development and soil productivity are often slowed by petroleum oil spills on the soil. They stress out plant a root, which in turn slows down the growth of their leaves. They also reduce aeration by clogging air gaps between soil particles, which causes the condition known as aerobiosis (Shukry et al., 2013). Significant volumes of pollutants have been continuously introduced into ecosystems as a result of urbanization and other factors. Metals are persistent pollutants that biomagnified in the food chain, posing a growing threat to both people and wildlife (Begum et al., 2009).

The purpose of the current study is to investigate the levels of trace elements or metal contamination in certain agricultural products as a result of environmental and toxicological effects of trace metal contamination in account of crude oil leakage or spill. Samples of potato, raw papaya, tomato, raw banana, brinjal, lime, leafy vegetables, carrot, and ladies fingers have been collected which are grown from the areas around oil drilling sites in the Sivasagar district like Deudubi (SV1,SV2), Bhatiapar (SV3,SV4,SV5), Gaurisagar (SV6,SV7,SV8), Patkai (SV9,SV10), Bokota (SV11,SV12,SV13), Lakwa (SV14,SV15), Gelakey (SV16,SV17) and Rudrasagar (SV18,SV19,SV20) in order to research the effects of oil drilling on agricultural products. The control sample (CV) is collected for each vegetable sample from the location where no oil drilling operation is observed. The main objective of this study was to generate reliable data that could be compared to past, present, and future data, as well as current results from other parts of the world and existing limits and guidelines, regarding the impact of heavy metals that have accumulated due to oil spill in some selected vegetables grown around oil drilling sites in the Sivasagar district. The results of this study are therefore absolutely crucial from the perspectives of health and the environment. The vegetable samples grown near the oil drilling sites were subjected to heavy metal analysis for Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb and Zn and the results were compared with the control samples where no oil drilling installations were carried out.

2. MATERIALS AND METHODS

Raw material and its characterization

Different types of vegetable samples like potato, raw papaya, tomato, raw banana, brinjal, lime, leafy vegetables, ladies finger and carrot have been gathered from the area around oil drilling sites in the Sivasagar district in order to research the effects of oil drilling on agricultural products. Control samples have been collected from the areas where no oil exploration have been taken place and were compared with the results of the collected samples from affected area.

Samples of potato, raw papaya, tomato, raw banana, brinjal, lime, leafy vegetables, carrot, and ladies fingers have been collected which are collected around the areas of oil drilling sites in the Sivasagar district like Deudubi, Bhatiapar, Gaurisagar, Patkai, Bokota, Lakwa, Gelakey and Rudrasagar in order to research the effects of oil drilling on agricultural products. The sampling locations, sampling codes and geographical co–ordinates are summarized in Table 1 as shown below.

Table 1: The Sampling Location and Geographical Co Ordinates of Oil Drilling Sites of Sivasagar District

Sampling Location	**Sampling Code of Vegetables**	**Geographical Co-ordinates**	
		Latitude	**Longtitude**
Deudubi 1	SV1	27.1269° N	94.7400° E
Deudubi 2	SV2	27.1269° N	94.7400° E
Bhatiapar1	SV3	27.02986°N	94.79281°E
Bhatiapar2	SV4	27.02986°N	94.79281°E
Bhatiapar3	SV5	27.02986°N	94.79281°E
Gaurisagar 1	SV6	26.9420° N	94.5367° E
Gaurisagar 2	SV7	26.9420° N	94.5367° E
Gaurisagar 3	SV8	26.9420° N	94.5367° E
Patkai 1	SV9	27.0000° N	96.0000° E
Patkai 2	SV10	27.0000° N	96.0000° E
Bokota1	SV11	26.9952°N	94.6972°E
Bokota2	SV12	26.9952°N	94.6972°E
Bokota3	SV13	26.9952°N	94.6972°E
Lakwa 1	SV14	27.01356°N	94.85725°E
Lakwa 2	SV15	27.01356°N	94.85725°E
Gelakey 1	SV16	26.7959° N	94.6915° E
Gelakey2	SV17	26.7959° N	94.6915° E
Rudrasagar 1	SV18	26.9547°N	94.60019°E
Rudrasagar 2	SV19	26.9547°N	94.60019°E
Rudrasagar 3	SV20	26.9547°N	94.60019°E
Control Sample	CV	26.9167°N	94.7667°E

Experimental procedure and Analysis

Analysis of concentration of lead present in potato, cadmium present in raw papaya, copper present in tomato, cobalt present in raw banana, nickel present in brinjal, chromium present in lime, iron present in leafy vegetables, manganese present in carrot and zinc present in ladies finger were carried out.

The samples were transported to the laboratory in polythene bags, cleaned with distilled water, dried in an air oven a.t 60 to 80 °C. All subsequent determinations were reported with reference to this dry weight, which was taken into consideration as the dry weight of the vegetable species. Following oven drying, the vegetable samples were calcined at 600–800°C, ground into a powder, and stored in clear polythene bottles for subsequent examinat.

Each plant species calcined powder was digested for three hours at medium heat using a combination of the three acids HCl, HNO_3, and H_2SO_4 [4 parts H_2SO_4 (Sp. gravity = 1.84), 2 parts HCl (Sp. gravity = 1.19) and 1 part HNO_3 (Sp. gravity = 1.40)]. The mixture was heated gradually at first, then more vigorously until no longer emitting white vapours. The digested samples were heated, diluted HCl (1:1) was added, and then they were filtered through Whatman 42 filter paper after being washed multiple times with distilled water. The filtrate was diluted to a level of 50 ml. Then, using a Thermo iCE3400 Atomic Absorption Spectrophotometer and the following calculation procedure, the filtrate was examined for the presence of metals.

$$Metal\ concentration\ \ mg/kg = \frac{P \times Q \times R}{W}$$

$$Where,\ P = Concentration\ of\ metal\ in\ digested\ solution$$

$$Q = Final\ volume\ of\ digested\ solution\ in\ ml$$

$$R = Dilution\ ratio$$

$$W = Amount\ of\ the\ sample\ taken\ for\ extraction$$

3. RESULTS AND DISCUSSION

Characterization of vegetable samples

The estimated concentration of the trace metals present in collected vegetable samples from different oil drilling sites were summarized in Table 2 as shown below.

Table 2: The Concentration of the Metals (mg/kg) Present in Agricultural Products of Oil Drilling Sites of Sivasagar District

Sampling Code for Vegetables	Pb (mg/Kg) in potato	Cd (mg/Kg) in raw papaya	Cr (mg/Kg) in lime	Fe (mg/Kg) in leafy vegetable	Cu (mg/Kg)in tomato	Mn (mg/Kg) in carrot	Ni (mg/Kg) in brinjal	Zn (mg/Kg) in ladies finger	Co (mg/Kg) in raw banana
SV1	0.694	0.069	0.034	0.649	0.086	0.854	0.068	2.068	0.786
SV2	0.439	0.052	0.018	0.198	0.027	0.143	0.028	0.628	0.042
SV3	0.360	0.097	0.049	1.392	0.054	0.193	0.079	0.898	0.646
SV4	0.720	0.009	0.074	2.480	1.232	0.639	0.087	3.044	0.967
SV5	0.242	0.176	0.068	0.552	0.090	0.342	0.023	0.328	0.432
SV6	0.049	0.086	0.019	0.654	0.063	0.454	0.078	0.869	0.568
SV7	0.280	0.091	0.043	0.264	1.134	0.654	0.064	0.534	0.349
SV8	0.010	0.072	0.025	0.163	0.091	0.734	0.056	1.108	0.023

SV9	0.347	0.021	0.026	1.102	0.039	0.184	0.059	0.694	0.058
SV10	0.239	0.169	0.032	0.964	0.934	0.469	0.340	0.968	0.086
SV11	0.680	0.034	0.056	0.064	0.084	0.269	0.360	0.468	0.095
SV12	0.386	0.008	0.012	0.329	0.073	0.667	0.030	0.721	0.091
SV13	0.247	0.054	0.024	0.087	0.054	0.214	0.045	0.302	0.058
SV14	0.415	0.098	0.056	0 .782	0.097	0.358	0.084	0.987	0.154
SV15	0.198	0.154	0.039	0.958	0.085	0.423	0.062	1.258	0.398
SV16	0.287	0.085	0.046	0.825	0.241	0.522	0.115	0.797	0.493
SV17	0.369	0.078	0.028	0.468	0.186	0.189	0.096	1.025	0.285
SV18	0.98	0.146	0.052	0.322	0.463	0.228	0.082	0.874	0.149
SV19	0.124	0.082	0.036	0.098	0.385	0.286	0.105	1.258	0.255
SV20	0.652	0.079	0.058	0.623	0.654	0.385	0.231	0.870	0.653
CV	0.030	0.002	0.006	0.043	0.012	0.114	0.020	0.102	0.034
Minimum	0.01	0.008	0.012	0.023	0.027	0.143	0.023	0.302	0.023
Maximum	0.98	0.176	0.074	0.360	1.232	0.854	0.361	3.044	0.967
Mean	0.38	0.083	0.039	0.104	0.303	0.410	0.104	0.984	0.329
Skewness	0.74	0.411	0.311	2.042	1.580	0.610	2.042	2.232	0.787
Kurtosis	0.28	0.268	0.749	3.404	1.283	-0.667	3.408	6.174	0.142
Standard Deviation	0.24	0.048	0.017	0.094	0.382	0.209	0.094	0.620	0.279

Table 2 summarizes the concentration of different metals like Pb, Cd, Cr, Fe, Cu, Mn, Ni, Zn and Co in vegetables grown around oil drilling locations. SV2 having higher concentration of metals such as Pb (0.694mg/kg), Cr (0.034mg/kg), Fe (0.649mg/kg), Mn (0.854mg/kg) and Zn (2.068mg/kg) compared to SV1 of the same area covered. Similarly, comparing the concentration of metals in location SV3, SV4, SV5 it is observed that location SV5 corresponds to a decrease in amount of metals as Pb (0.242mg/kg), Fe (0.552mg/kg), Ni (0.023mg/kg), Zn (0.328mg/kg) and Co (0.432mg/kg). On the other hand, SV4 is showing an increase in concentration of metals compared to both SV3 and SV5 with Pb (0.720mg/kg), Cr (0.074mg/kg), Fe (2.480mg/kg), Cu (1.232mg/kg), Mn (0.639mg/kg), Ni (0.087mg/kg), Zn (3.044mg/kg) and Co (0.967mg/kg) respectively. Location SV6, SV7 and SV8 covering the same area also represents a considerably higher amount in Cu, Zn and Mn. A higher range is observed in values for Fe in case of SV9 and SV10 compared to the control sample (0.043mg/kg).Metals like Pb, Zn and Cr exhibits a higher value in concentration showing accumulation of it in the vegetables.

In SV11, SV12 and SV13 the Pb content in selected vegetables showed an increase in its concentration which is nearby ten times than the control. The concentrations of Cu, Mn, Ni and Co are not showing a major increase in their concentration in the examined vegetables. The amount of Zn (1.258mg/kg) and Fe (0.958mg/kg) is found higher for SV15 compared with SV14 samples. The major accumulation of Zn is observed in SV16, SV17 compared to the other metals. The areas covering SV18, SV19 and SV20 is showing a rise in concentration of metals such as Pb, Cr, Cu, Ni, Zn and Co which is tabulated in table 2.

Lead (Pb): The concentration values of lead in potato were found in the range 0.01 mg/kg to 0.98 mg/kg. Area SV8 (Gaurisagar 3) has the lowest Pb concentration as shown in Figure 3. Pb was found to be most concentrated in the area SV18 (Rudrasagar 1) while the control sample has a concentration of 0.03 mg/kg. The average was measured at

0.38 mg/kg. The graphical comparison of minimum, maximum, mean, skewness, kurtosis and standard deviation values are shown the Figure 3. The air, water, and soil have all become more contaminated with lead and its compounds as a result of human activities including mining, manufacturing, and burning fossil fuels. According to Martin and Griswold (2009), metals like pipes, solder, and bullets are used to produce batteries, cosmetics, and other items. Lead poisoning was seen as a classic disease that mostly affected the gastrointestinal tract and central nervous system in both adults and children (Markowitz, 2000).

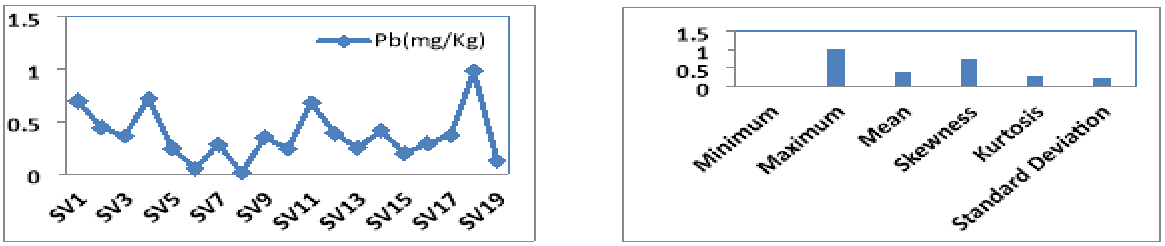

Fig.3: The Variation Pattern of Concentration of Pb (mg/kg) Present and Bar Diagram of Descriptive Statistics of Pb (mg/kg) Present in Potato

Cadmium (Cd): The concentration levels of Cadmium in raw papaya were measured from 0.008 mg/kg to 0.176 mg/kg. Figure 4 depicts the areas with the lowest and greatest cadmium concentrations respectively. The lowest concentration was found in the region SV12 (Bokota 2), and the highest was found in the area SV5 (Bhatiapar 3). The control sample, where there are no oil drilling installations, has a cadmium value of 0.002 mg/kg. 0.083 mg/kg was discovered to be the mean value. In Figure 4, the lowest, maximum, mean, skewness, and kurtosis data are graphically compared to values from the control sample. Positive skewness and kurtosis values for the concentration show a flat distribution with a big right tail in comparison to a short left tail. Negative skewness values result in a distribution with a significant long left tail. Three-fourths of the electrodes in alkaline batteries are made of cadmium; the remainder is used as a plastic stabiliser, in coatings, pigments, and platings. This metal could be consumed by people. Increased absorption of the metals by plants causes them to concentrate down the food chain and ultimately into the human body (Bernard, 2008; Mutlu et al., 2012). Because of its high rate of soil-to-plant transfer, cadmium is most commonly discovered in fruits and vegetables (Satarug et al., 2011). According to Irfan et al. (2013), cadmium is a very hazardous heavy metal that has been connected to oxidative stress, plant nutritional deficiencies, and adverse impacts on cellular enzyme systems.

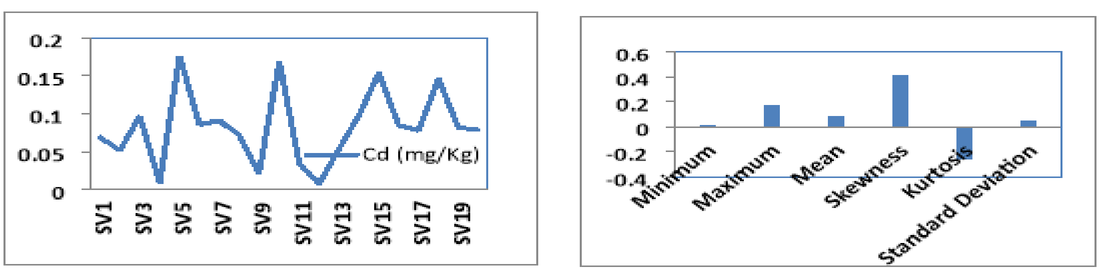

Fig.4: The Variation Pattern of Concentration of Cadmium in raw papaya and Bar Diagram of Descriptive Statistics of Cd (mg/Kg) in raw papaya

Chromium (Cr): The concentration of chromium in lime was calculated to be in between 0.012 mg/Kg and 0.074 mg/kg. The location SV12 (Bokota 2) reported the lowest concentration of chromium, and the area SV4 recorded the greatest concentration (Bhatiapar 2). The mean value was calculated as 0.039 mg/kg. Negative values of skewness give a distribution having significant long left tail. Here the distribution having negative kurtosis is said to be platykurtic i.e., the distribution is having a flatter peak and thinner tails compared to a normal distribution. This only indicates that there are more data points close to the mean values and less data points on the distribution tail side. According to Martin and Griswold (2009), chromium can be found in the workplace through protective metal coatings, metal alloys, magnetic tapes, paint pigments, rubber, cement, paper, wood preservatives, leather tanning, and metal plating. Erythrocyte glutathione reductase inhibition brought on by increased exposure to chromium compounds may impair ability of a person to convert methemoglobin into hemoglobin (Koutras et al., 1965; Schlatter & Kissling, 1973).

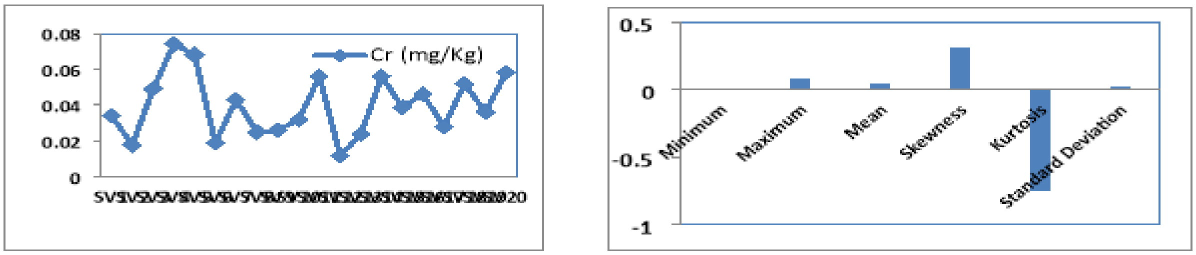

Fig.5: The Variation Pattern of Concentration of Chromium in lime and Bar Diagram of Descriptive Statistics of Cr (mg/kg) Present in Lime

Iron (Fe): The concentration of iron in leafy vegetables was found in the range of 0.064 mg/kg to 2.48 mg/kg. The lowest concentration for iron was recorded for the area SV11 (Bokota 1) and highest concentration for iron for leafy vegetables was recorded for SV4 (Bhatiapar 2). The control sample has an iron value of 0.043 mg/kg and estimated mean value was 0.10 mg/kg. The majority of aerobic creatures rely on iron-mediated mechanisms to breathe. A inadequately protected organism may accelerate reactions that result in the production of radicals, which can harm biomolecules, cells, tissues, and the organism as a whole. Pediatricians have long had a special interest in iron poisoning. Children are particularly vulnerable to iron poisoning since they are exposed to so many items that contain iron (Albretsen, 2006).

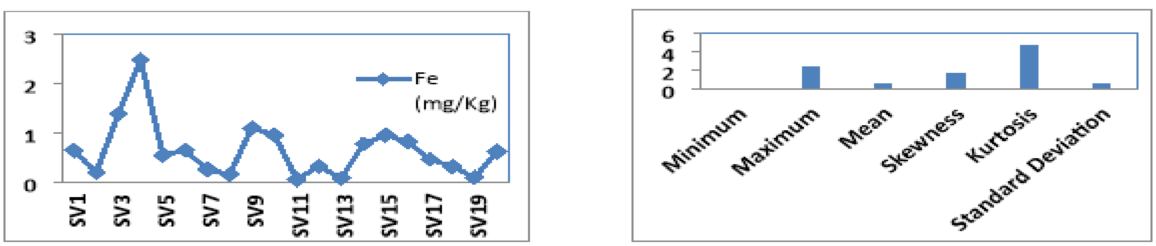

Fig.6: The Variation Pattern of Concentration of iron in leafy vegetables And Bar Diagram of Descriptive Statistics of Fe (mg/kg) Present in leafy vegetables

Copper (Cu): The calculated copper concentration in tomato values were found to be between 0.027 and 1.232 mg/kg. The location SV2 (Deudubi 2) had the lowest copper concentration in tomatoes, whereas the area SV4 recorded the highest concentration (Bhatiapar 2). The control sample has a copper content of 0.012 mg/kg. Quantities between 648 and 972 mg, copper is considered to be extremely dangerous to consume. At parts per billion (ppb) levels, Cu is also known to be toxic to some aerobic bacteria and to hinder lettuce from sprouting and growing roots (Smith et al., 1973). According to Athar and Vohora (1995), overly high copper dosages cause large-scale capillary damage, hepatic and renal damage, central nervous system irritation, and mucosal irritation and corrosion before leading to depression. Acute hemolysis, blue-green diarrhea, and compromised renal function can all be symptoms of copper intoxication. Wilson's disease affects the liver's ability to remove copper into the bile and is caused by a hereditary metabolic abnormality. Consequently, the accumulation of copper in the liver, brain, kidney, and cornea damages these organs. Wilson's disease is caused by a genetic defect in the way copper (Cu) is added to apocerplasmin to form ceruloplasmin (Krishnamurti & Viswanathan, 1991).

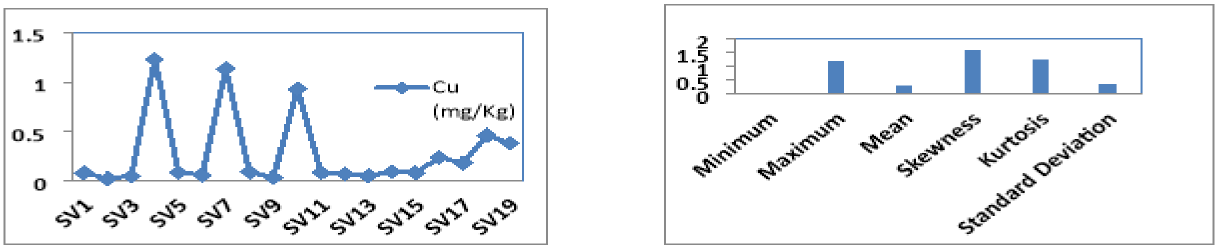

Fig.7: The Variation of Concentration of Cu (mg/kg) Present in Tomato and Bar Diagram of Descriptive Statistics of Cu (mg/kg) Present in Tomato

Manganese (Mn): Manganese concentrations in carrot were found to be between 0.143 mg/kg to 0.854 mg/kg. The area SV2 (Deudubi 2) had the lowest manganese content and the area SV1 (Deudubi 1) had the greatest manganese concentration. The control sample has a manganese content of 0.114 mg/kg whereas mean value was calculated as 0.410 mg/kg. Adults are considered to need between 2.5 and 5.0 mg of manganese per day, an important nutrient (NRC-NAS, 1980). Human toxicity results in an acute poisoning effect at greater concentrations. Manganism is a neurological condition caused by inhaling fumes from Mn dust (Brown & Kodama, 1986). According to Athar and Vohora (1995), magnesium affects systolic blood pressure, erythropoesis, granulocyte production, and the disruption of 17-ketosteroid excretion.

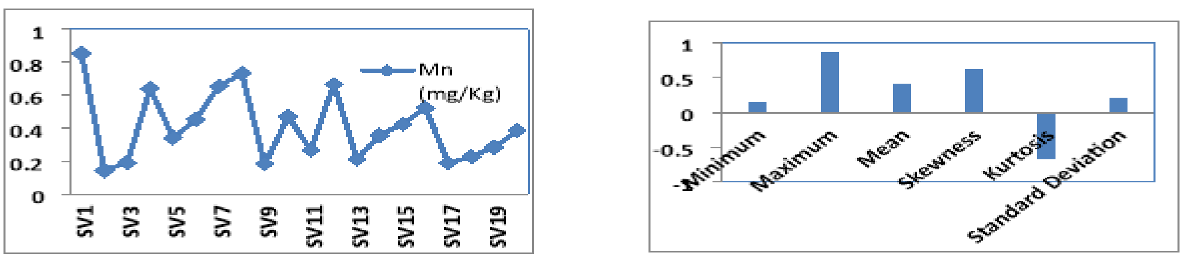

Fig.8: The Variation of Concentration of Mn (mg/kg) Present in Carrot and Bar Diagram of Descriptive Statistics of Mn (mg/kg) Present in Carrot

Nickel (Ni): Nickel found in brinjal was present in concentrations ranging from 0.023 mg/kg to 0.36 mg/kg. The lowest concentration for nickel was recorded for the area SV5 (Bhatiapar 3) and highest concentration for it was recorded for the area SV11 (Bokota1). Control sample has a nickel content of 0.02 mg/kg. For nickel, a mean value of 0.010 mg/kg was reported. Nickel sensitivities can also emerge in the general public as a consequence of exposure to coins, jewellery, watchcases, clothing, and fasteners. It results in asthma, eocinophilic pheumonites, conjunctivitis, and local or systemic reactions to prosthetics that include nickel, including pacemaker wires, dental inlays, joint replacements, pins, and heart valve replacements (Athar & Vohora, 1995). Lung fibrosis, respiratory tract cancer, and skin allergies may manifest in populations exposed to nickel during work. Additionally, nickel may cause lung cancer (Kasprazak et al., 2003). Consuming too much nickel from foods like tea, beans, and vegetables cultivated in soils high in nickel increases the chance of getting malignancies of the lungs, nose, larynx, and prostate as well as respiratory problems, birth defects, and heart problems (Duda-Chodak & Blaszczyk, 2008; Lenntech, 2009).

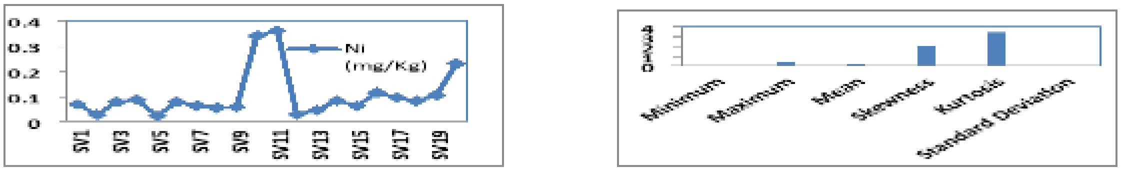

Fig.9: The Variation of Concentration of Ni (mg/kg) Present in Brinjal and Bar Diagram of Descriptive Statistics of Ni (mg/kg) Present in Brinjal

Zinc (Zn): The concentration level was found to be 0.302 mg/kg and 3.044 mg/kg for zinc in ladies finger. Zinc concentrations ranged from the lowest in the region SV13 (Bokota 3) to the highest in the area SV4 (Bhatiapar 2). The control sample is having the concentration of 0.102 mg/kg and means value was found as 0.984 mg/kg. An essential part of our diet is zinc. However, too much zinc might be harmful. Typically, harmful consequences begin 10 to 15 times greater than what is needed to maintain health. Taking high amounts might cause stomach trouble, even for a short time, resulting in cramping, nausea, and mouth vomiting. Longer wait times might impair healthy cholesterol levels and cause anaemia. It is uncertain if having too much zinc has any consequences (U.S. DPHHS, 2005). In humans, acute Zn poisoning leads to nausea, vomiting, dehydration, sleepiness, lethargic behavior, electrolyte imbalance, abdominal discomfort, and renal failure, according to Prasad and Oberleas (1976). Chronic Zn exposure raises the risk of anaemia, pancreatitis, reduced HDL cholesterol, higher LDL cholesterol, and may exacerbate Alzheimer's disease symptoms (Athar & Vohora, 1995). Instances of mental fume fever have been reported in workers who have been exposed to Zn fumes from welding or melting.

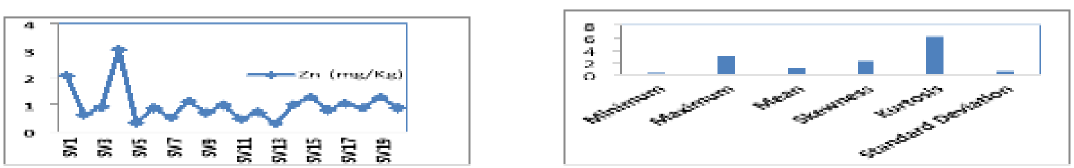

Figure 10: The Variation of Concentration of Zn (mg/kg) Present in Ladies Finger and Bar Diagram of Descriptive Statistics of Zn (mg/kg) Present in Ladies Finger

Cobalt (Co): The amount of cobalt found in raw bananas from oil drilling sites that were collected from different locations in the Sivasagar is ranged from 0.023 mg/kg to 0.967 mg/kg. The area SV8 (Gaurisagar3) reported the lowest cobalt concentration, whereas the area SV4 recorded the highest cobalt concentration (Bhatiapar 2). The control sample is having the concentration of 0.034 mg/kg while the mean value was found as 0.32 mg/kg. Cobalt can be produced as a result of human activities and is exceedingly prevalent in the natural environment (Ortega et al., 2009). It makes up a small portion of sulphate and arsenic-containing compounds. This material is employed in many industrial processes, such as nuclear power plants, grinding, welding, chemical catalysis, and the manufacture of diamond tools (Roesems et al., 2000). This vital component comes in both organic and inorganic forms. Having too much or too little of the first type would be harmful, even though it is vital and necessary for the human body. Water, fish, grains, and the green portions of plants all contain the organic form of cobalt (Unice et al., 2012; Galanis et al., 2009).

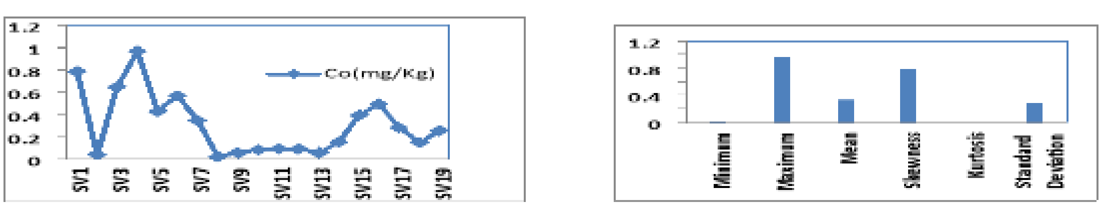

Figure 11: The Variation of Concentration of Co (mg/kg) Present in Raw Banana and Bar Diagram of Descriptive Statistics of Co (mg/kg) Present in Raw Banana

4. CONCLUSION

Drilling fluids had a significantly smaller effect on the final plant concentration than did crude oil. Although the other treatments did not differ statistically significantly, the plant density attained in the control treatment was statistically greater than that of the other treatments (Kisic et al., 2009). Because zinc is directly introduced to drilling fluids as zinc carbonate and works as a corrosion inhibitor for mud formations, it can be a pollutant, particularly in locations near industrial units that handle petroleum. Furthermore, the soil layer may trap some of the zinc (Asia et al., 2007). Most trace heavy metals are considerably mobilized in soils after flooding, especially when highly oxidizable organic components are present. After floods, soluble Ni and Pb concentrations have a tendency to rise, which is exacerbated worse by the fact that more elements are mobilized in this way. Therefore, when assessing the potential dangers related to compounds enhanced with organic carbon. It's crucial to consider the mobility, chemical composition, and physicochemical characteristics of the soil when assessing trace heavy metals found in crude oil (Alexander, 1961; Clark, 1976). High levels of some trace metals in soils may enhance plant uptake, which may lead to bioaccumulation in plants and the animals that depend on them, which may subsequently result in dangerous food chain events. Our findings suggest that heavy rain, its weathering, and flooding may cause the majority of trace elements in the soil to be significantly mobilized and redistributed, rather than providing enough scientific evidence to prove that the soil under investigation are exclusively the result of an oil leak (Osuji.,2004).

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