4

International Practices in Solid Waste Management

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1. Introduction

Emergent urbanization and changes in the pattern of life, give rise to generation of increasing quantities of wastes and it's now becoming another threat to our already degraded environment. However, in recent years, many programs were undertaken for the control of urbanization gift in the world because the dumping of industrial wastage without proper treatment, responsible for the lowering of a soil fertility, which increases the amassing of essential and non essential trace metals in the plants. On the other hand domestic waste management in a soil and aquatic resources are also accountable for the reduced field productivity. At this time the world is now facing an extreme situation of waste management from both the side i-e from industrialization and municipal waste management especially in a under developing countries. There is a need to address both problems in such a way that there should be resolution which can give proper management of both kind of waste. For this purpose public awareness about the waste management can play a crucial rule in controlling the waste of both the sides.

One of which waste-to-energy technologies have been developed to produce clean energy through the combustion of municipal solid waste in specially designed power plants equipped with the most modern pollution control equipment to clean emissions. Other waste management includes recycling of waste into fertilizers for use agriculture which is a common practice of waste management. The recycling of hazardous industrial wastes into fertilizers introduces several dozen toxic metals and chemicals into the nation's farm, lawn and garden soils, including such well-known toxic substances as lead and mercury. Many crops and plants extract these toxic metals from the soil, increasing the chance of impacts on human health as crops and plants enter the food supply chain. The report based on the use of recycle fertilizers from waste in agriculture industry represent the highly toxic substances found by testing fertilizers, as well as the strict regulations needed to protect humans and the environment from these toxic hazards.

Between 1990 and 1995, 600 companies from 44 different states sent 270 million pounds of toxic waste to farms and fertilizer companies across the country [(1) Shaffer 1998]. The steel industry provided 30% of this waste. Used for its high levels of zinc, which is an essential nutrient for plant growth, steel industry wastes can include lead, arsenic, cadmium, chromium, nickel and dioxin, among other toxic substances. Although the industrial facilities that generate these toxic wastes report the amount of chemicals they transfer off-site to the U.S. Environmental Protection Agency's (U.S. EPA) Toxics Release Inventory every year, they only report the total amount of a given chemical contained in wastes transferred over the course of a year, making it difficult to determine the chemical make-up of a given waste shipment. With little monitoring of the toxics contained in fertilizers and fertilizer labels that do not list toxic substances, our food supply and our health are at risk.

2. Tested fertilizers contain harmful toxic metals

California Public Interest Research Group (CALPIRG) Charitable Trust and Washington's Safe Food and Fertilizer tested 29 fertilizers from 12 states (2) for 22 toxic metals. This report documents the results of these fertilizer samples, demonstrates that the problem of toxic fertilizers is widespread, and details concerns with proposed regulations for the practice.

3. Toxic fertilizers threaten human health

The toxic substances found in the tested fertilizers have been linked to adverse human health impacts. The metals found in these fertilizers are known or suspected carcinogens, reproductive and developmental, liver, and blood toxicants. For example, beryllium is a suspected carcinogen, chromium and arsenic are known to cause cancer and barium can cause kidney and lung damage. Children are most susceptible to the toxic effects of most metals, especially lead, which has been the subject of intense government efforts to reduce lead exposure to children. Products like fertilizer are of great concern as children spend more time on or near the ground and are often exposed to ground level substances through hand-to-mouth behavior(3-5).

4. Toxic fertilizers pressure agricultural soils, food safety and waterways

As demonstrated in this report, the tested fertilizers contain toxic substances at high levels. These substances can accumulate in agricultural soils, become available for plant uptake, and run off into waterways (5).

5. Agricultural soil quality

Farming, especially single-crop farming, requires consistent and dependable soil conditions. The introduction to farm soils of toxic substances like lead and cadmium can adversely affect growing conditions and result in increased toxic accumulation as these metals are highly persistent in soils. This can negatively affect critical growing requirements, such as soil acidity or the solubility of beneficial metals like zinc in the soils.

6. Plant uptake

Some crops are more likely than others to absorb non-nutrient toxic substances from soils. For example, fruits and grains can absorb lead, and lettuce, corn and wheat can absorb cadmium from soils. This means that our food supply is at risk of contamination by toxic substances that could threaten human health.

7. Water quality

The overall health of the nation's waterways has declined dramatically over the last quarter-century. Forty percent of our rivers, lakes, and estuaries are still too polluted for safe fishing or swimming (7). Agricultural runoff is a common cause of waterway pollution. A 1998 U.S. EPA report found that metals are the second most common pollutants found in lakes, ponds, reservoirs, and estuaries. In fact, agriculture is the industry most responsible for lake pollution (8). The introduction of toxic substances from fertilizers to agricultural environments will only add to their concentrations in waterways that state and federal agencies are working to make safe for fishing and swimming.

Hazardous waste is usually viewed directly as a health hazard to humans. However, pollution in the form of hazardous waste can have a much more pronounced effect on the plants and animals of our environment. According to the Environmental Protection Agency, "When chemicals are disposed improperly, they can have harmful effects on humans, plants, and animals." By learning how hazardous waste affects the environment in a negative fashion, it's possible to recognize the threat and act (9-10)

8. Evolutionary

Hazardous waste also has the power to shape evolutionary changes. When species survival is threatened by pollution, the species must either adapt or become extinct. This is seen frequently in the case of antibiotic-resistant bacteria. This is also seen in the case of the peppered moth. According to Time magazine, "Since the passage of smoke-control laws in the 1950s, England's landscape has begun to emerge from its layers of soot. The cleaner trees or phytoremediator thus provide a lighter and safer resting place for any surviving speckled moths." The soot created by transport or industrial pollution in England or in Pakistan made the bark of tree's black, making it extremely easy for a speckled peppered moth to be seen, and thus eaten. However, since pollution control laws were enacted in the 1950s in England, the bark of trees has become lighter, thus creating evolutionary pressure that once again favors the speckled peppered moth, versus the black peppered moth, which the presence of pollution favored (11-13).

9. pH Change and oxygen depletion

According to National Geographic, "When humans burn fossil fuels, sulfur dioxide and nitrogen oxides are released into the atmosphere. These chemical gases react with water, oxygen, and other substances to form mild solutions of sulfuric and nitric acid." The change of pH caused by acid rain can have drastic effects on the plants and animals of the environment. It is also a one of the basic reason of Al toxicity in plants in acidic soil which was already reported by many researchers.(Azmat et al 2007). Entire forests, rivers and lakes can die due to the acidity of acid rain. Oxygen depletion in water originates from the overuse of fertilizers as well as hazardous waste. When a substrate such as oil or fertilizer is consumed by bacteria in water, it reduces the available oxygen for plants and fish.

Oxygen depletion can also be related with accumulation of heavy metals in the aerial parts of plant due its mobility in soil and plant uptake of heavy toxic metals due to which plants adopt certain survival strategy to overcome the stress like lignin deposition in vascular tissues or in veins or thickening of stomata to control the water evaporation but side effects was dominants i-e exchange of gasses viz CO_2 and O_2 as oxygen will not released due to smaller size of stomata it will produced oxidative stress in plants which is a common property of heavy metal accumulation (Azmat et al 2009). This ROS species will lead to increase the concentration of secondary metabolites and ultimately goes into food chain. When even small amounts of heavy metals or toxic chemicals are present in soil or water, their concentration is greatly amplified during travel up the food chain. This causes potentially lethal or trouble some concentrations of pollutants to be present in plants and animals. According to Young People's Trust for the Environment, "organo-chlorines caused many birds to lay thin shelled eggs, which cracked easily " (11-13).

In under developing countries using sewage sludge in agriculture fields is the risk of soil contamination with heavy metals and their possible transference to humans via food chain. Heavy metals, however, are regarded as inhibitors of enzymatic and microbiological activity of soil. This is because if added to soil (whether on purpose or by accident) they cause quantitative and qualitative changes in the composition of microflora and in enzymatic activity.

The new technologies in controlling waste based on adsorptions but if surface already heavily contaminated by adsorbates is not likely to have much capacity for additional binding. Up till now freshly prepared activated carbon which has a clean surface is use as adsorbing material and charcoal made from roasting wood differs from activated carbon in that its surface is contaminated by other products, but further heating will drive off these compounds to produce a surface with high adsorptive capacity. Although the carbon atoms and linked carbons are most important for adsorption, the mineral structure contributes to shape and to mechanical strength. Spent activated carbon is regenerated by roasting, but the thermal expansion and contraction eventually disintegrate the structure so some carbon is lost or oxidized. New adsorbents like seaweeds powder and solid tea wastage for controlling the heavy metal accumulation in plant are cost effective techniques

10. Use of natural resources and domestic wastage for effective remediation of toxic metals

Natural resources hidden in the sea are becoming more and more important in human life. It is an establishing fact that seaweeds are full of innumerable wealth of bioactive properties [Azmat et al., 2006a]. Seaweeds has been used by plant growers for centuries but the reason for beneficial results has only recently been attributed to the naturally occurring growth regulators and micro nutrients in the seaweed. The green alaga, Bryopsis Corymbasa/ codium iyengrii was found to display an antifungal activity [Azmat et al., 2006b]. Many types of seaweed have been used as food since they are not poisonous and usually have soft tissues. Seaweeds selectively, absorb from the seawater, elements like Na, K, Ca, Mg, Cl, I and Br, which are accumulated in their thalli. Seaweeds are known as alkaline food since their inorganic components play a very important role in preventing blood acidosis [Azmat et al., 2007]. The seaweeds can be used directly on the plant in the form of a spray and minerals in seaweed spray are absorbed through the skin of the leaf into the sap with not only mineral but auxins too. Seaweed sprays stimulate metabolic processes in the leaf and so helped the plant to exploit leaf locked nutrients and thus increase the rate of photosynthesis. Seaweeds could also be helpful in controlling the acidity of soil due to its alkaline nature

Although a lot of work on seaweed has been done on their taxonomy, distribution, morph-ecological studies, phytochemistry and antibacteial activity, but diminutive data is available in literature related to control the toxicity of heavy metal contaminated water. Therefore two research works were undertaken to control the toxicity of heavy metals by processes of adsorption or biosorption from proteins and nutrients of seaweed and tea wastage, for the management of toxic waste by domestic waste.

Biosorption (adsorption through living marine algae or microorganism) used for removing heavy metals and other pollutants is a newly developed environmental protection technique (Azmat *et al*.,2006a & b). Adsorption (surface absorption) on seaweeds or tea solid surface was found to be a promising alternative method to treat industrial effluents, mainly because of its low cost and high metal binding capacity (Kailas *et al.,* 2007; Utomo & Hunter, 2006; Yan-xin, 2001; Cay *et al.,* 2004) within a contaminated soil. These are low cost and easily available adsorbent and having strong adsorptivity towards metals like Cd, Zn, Ni, and Pb (Amarasinghe & Williams, 2007; Singh *et al.,* 1993; Ahluwalia & Goyal, 2005) because of the soft colloid and chemical components like palmitic acid of fatty group, terpenes and di-Bu phthalate present in it (Amarasinghe & Williams, 2007; Shyamala *et al.,* 2005; Mahvi *et al*., 2005). In under developing countries using sewage sludge in agriculture fields is the risk of soil contamination with heavy metals and their possible transference to humans via food chain (Quaff & Ashhar, 2005). Heavy metals, however, are regarded as inhibitors of enzymatic and microbiological activity of soil. This is because if added to soil (whether on purpose or by accident) they cause quantitative and qualitative changes in the composition of microflora and in enzymatic activity (Wyszkowska, 2002).

Extensive studies on marine resources decontamination revealed that seaweeds can efficiently accumulate heavy metal, due to presence of polysaccharides, proteins which provides wide range of ligands for interaction with heavy metals ions and other macro and micronutrients(Same *et al*,2002; Stirk, & Staden., 2002 ; Schiewer & Wong 2000). Seaweeds extracts are used at the recommended times and rates for increasing growth of plants (Azmat *et a*l.,2007). These extracts supply the amounts of iron, zinc, copper, molybdenum, cobalt, boron, manganese and magnesium that most crops require. They form complex with metals ions by changing the oxidation state of metal consequently detoxification is occurred (el- Sheekh & el – Saied. ,2000 ; Azmat *et al.,*2006b). Seaweed can be used directly on the plant in the form of a spray, which may directly absorb through skin of leaves or absorbed by the root. Seaweeds is a potential candidate algae for biosorption of a number of heavy metals, but little is known about the phytotoxicity of mercury (Hg) in different plant species, like distribution and phytotoxicity in the whole plant and at cellular level and its control by seaweeds. Bio availability of Hg in soil, uptake of Hg at phytotoxic level, growth retardation, affects on palisade and spongy parenchyma cells in leaves (Ahmed, 2003, Ladygein, 2004), collated deposition in the vascular bundles and change in vacuoles with electron dense material along the walls of xylem and phloem vessel (Ladygein & Semenova**,** 2003; Boulia *et al.,*2006)**.** Shaw and Rout (1998**)** observed significant inhibition of root elongation, which was more prominent with Hg than Cd leading to increase in the cell size grown in aquatic medium with Hg. Mor *et al.,* (2002) reported growth inhibitory effect of Mercuric chloride in cucumber leading to the disorientation of root and shoot, while hypocotyle elongation, growth and cell wall loosing in young *Phaseolus vulgaris* was observed due to inhibition of cell wall division in apical meristem region. Hg, which is common in irrigation water and soil sediments, causes irreversible damages in tissue structure of plants leading to reduction in the productivity of crops. Introduction of seaweeds in Hg contaminated soil results in the improvement of growth parameters which showed that marine plant spray or powdered form were effective in immobilization of toxic metal in the food chain via cop plants.

As already know that heavy toxic metals concentration in the environment is basically related with the industrial operations which are leather processing, refractory steel, and chemical manufacturing industries (Andaleeb *et al.*, 2008). Due to broad industrial use, metals are painstaking serious environmental pollutants, increasing day by day. Excess of Cr in the environment causes hazardous effects on all living beings including plants (Arun *et al.*, 2005). A gradual decrease were reported for various morphological parameters like root fresh and dry weights, shoot fresh and dry weights, and plant height with increase in Cr levels (Andaleeb *et al.*, 2008). Contamination of soil and water by chromium (Cr) is of recent concern. Cr also causes deleterious effects on plant physiological processes such as photosynthesis, water relations and mineral nutrition (Azmat & Khanum, 2005).This showed that soil contamination with heavy metal is now a day, a worldwide problem leading to agricultural losses and hazardous health problems as metals enter to food chain (Azmat & Khanum 2005 ; Azmat *et al.,* 2007). Also metals toxicity above certain threshold level important for the animal and human being but toxic at certain level for both. Samantaray *et al.,*(1998) reported that high concentrations of chromium exhibited severe chlorosis, necrosis and a host of other growth abnormalities and anatomical disorders including the regulation of the mineral metabolism, enzyme activity and other metabolic processes. Cr^{3+} taken up by plants because of its mobile nature in soil. Since trivalent and hexavalent Cr may interconvert in the soil and soil immobilize both trivalent and hexavalent chromium. It is difficult to asses separately the effects of the two types of Cr on plants. Consequently, it might be appropriate to use the term Cr toxicity in plants, (Arun *et al.,*2005) instead of toxicity of trivalent or hexavalent Cr. The effects of chromium on plant growth, crop yield, uptake and distribution in vegetative and reproductive parts are not yet fully understood. Although a number of studies were made to investigate the chemistry of chromium in soil and its uptake by plants and found that it a stimulant the plant growth (Arun *et al.,*2005) . Barcelo *et al*. (1985) described the inhibition of P and K translocation within the plant parts when bean plants were exposed to Cr in nutrient solutions. Some microbacteria were also used as a growth promoting agents in presence of heavy metals like Wani *et al.* (2008) reported the role of mesorhizobium strain RC3 in soil amended with Cr, he found that inoculation of RC3 strain results in plant growth-promoting substances which reduces the Cr by 14, 34, and 29 % in root, shoot and grains respectively with the increased in N contents by 40 to 46 % in root and shoot. Conventional methods to alleviate the toxicity of chromium include its chemical reduction followed by precipitation, ion exchange and adsorption on activated coal, alum or ash. Most of these methods require high energy or large quantities of chemicals.

The information available on the role of solid tea waste in soil contaminated by Cr on plants growth and their important nutritive value is of significant. Because it is only value reports which give the knowledge about the removal / control the mobility or remediation of toxic metal within the soil through complex formation (Azmat *et al*., 2010). Moreover, the report by Azmat *et al* (2010) discuss the effect of solid tea wastage on chromium activity on the growth promoting potentials of plants like potassium, phosphorus, protease and proline activity as a bio- indicator of environmental stress and their function in soil remediation (Azmat & Hira 2010). This research demonstrates the effect of solid tea wastage on chromium contaminated soil as a new technology to remediate the metal through adsorption on the surface of solid tea wastage, which immobilized the metal in the soil. The results of remediation have been checked on some important parameters of *Vigna radiata* which is very effective in the world of new technologies based on management of solid toxic wastage. This is the report which discusses the management of industrial waste by municipal waste management for beneficial purpose like immobilization of toxic metal within the soil and safe plants from environmental hazards.

11. Morphological and physiological parameters in presence of additive surface

Initially increase in the root length at lower concentration may be due to increased relative proportion of pith and cortical tissue layers that later on reduced at further increase in concentration of metals. The reduction in root growth could be due to the direct contact of seedlings roots with metal in the soil causing a collapse and subsequent inability of the roots to absorb water from the medium (Barcelo *et al*., 1986) or may related with the inhibition of root cell division/ root elongation or to the extension of cell cycle in the roots. Whereas the seedlings with tea waste showed approximate normal root length especially in the plants grown with thoroughly mixed tea wastage showed normal growth rate (Fig. 1) reflects the remediation of Cr or immobility or complex formation of metal with applied tea surface.

Fig. 1. Effect of tea wastage on bean plants in Cr contaminated soil

Observed adverse effects of Cr on plant height and shoot growth (Fig. 2) is successfully controlled by solid tea surface (Fig. 2). The reduction in plant height might be mainly due to the reduced root growth and consequent lesser nutrients and water transport to the above parts of the plant.

Fig. 2. Effect of tea wastage on bean plants in Cr contaminated soil

The research investigation revealed that metals like Cr, Cd and Hg causes significant decrease in fresh and dry weight, of root and shoot, protein, carbohydrate, chlorophyll and carotenoids in plants under study (*Vigna radiate)* while application of seaweeds in contaminated nutrient solution causes significant healthy growth (Fig.3 & 4)

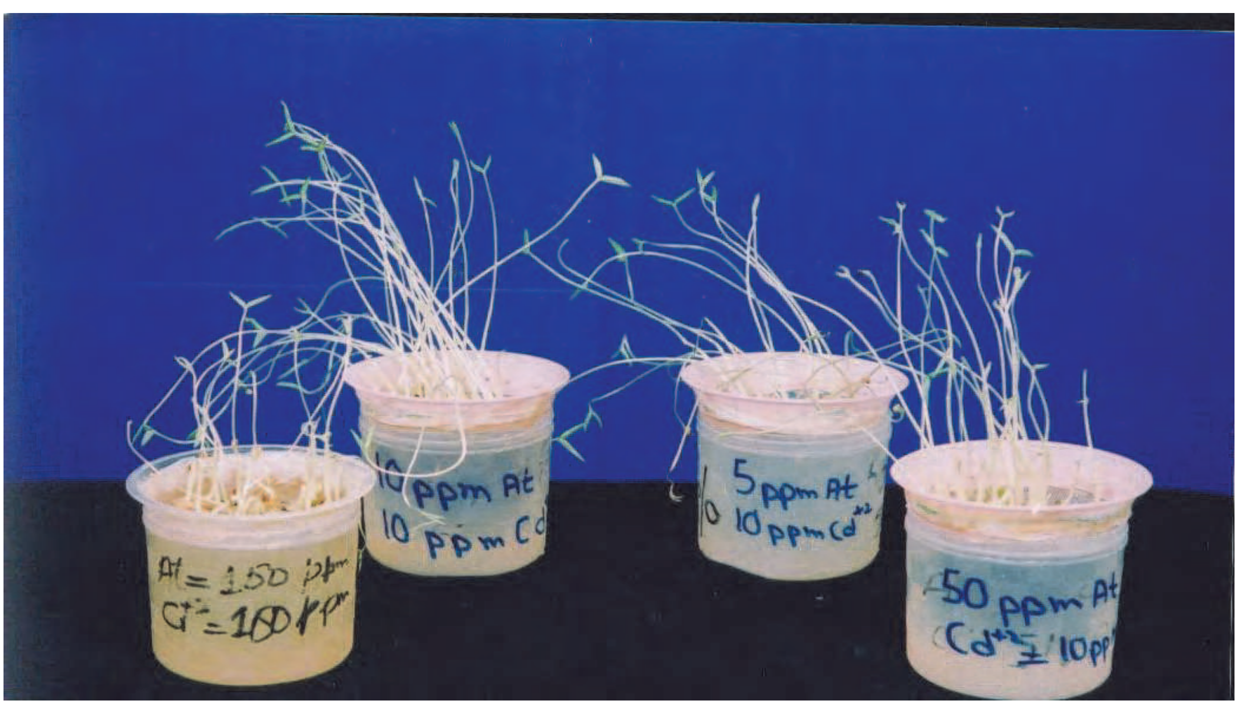

Fig. 3. Effect of Cd metal on Bean Plant

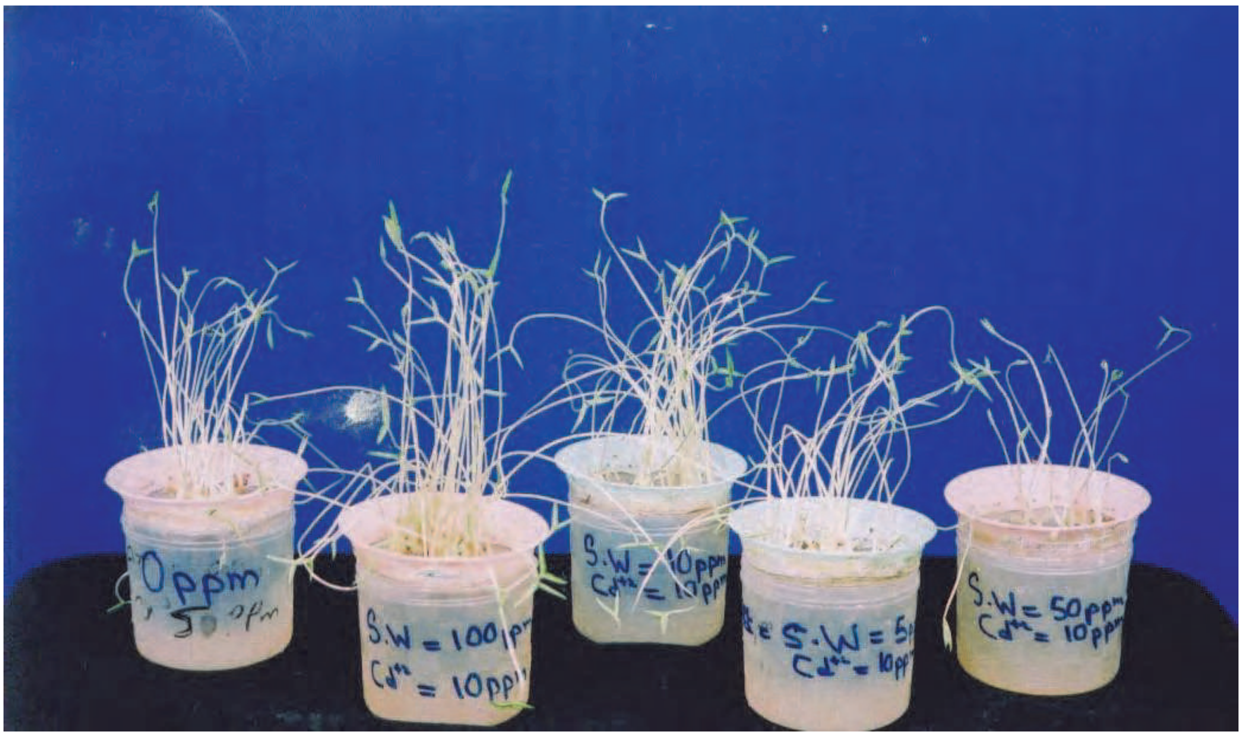

Fig. 4. Effect of seaweeds in presence of Cd on bean plants

The accumulation of chromium by germinating seedlings appears to be significantly affected by Cr concentration and occurred in a linear manner (Azmat *et al.*, 2005). Cr-treated plants showed growth depression and decrease in fresh and dry weight. It was found that dry matter production was severely affected by Cr(III) concentrations greater than 100 ppm. The reduction in plant height might be mainly due to the reduced root growth and consequent lesser nutrients and water transport to the above parts of the plant. In addition to this, Cr transport to the aerial part of the plant can have a direct impact on cellular metabolism of shoots contributing to the reduction in plant height. The effect of Cr on water relations was highly concentration dependent, and primary and first trifoliate leaves were affected differently (Azmat *et al.*, 2007). The seedlings which were grown in spreaded tea wastage and soil mixed with the tea wastage showed remarkable effect on the growth as well as physiological parameters. There were significant improvements in growth of the plants, indicated the adsorption of toxic metal on surface applied which were effectively controlled the mobility of metal within soil on applied domestic waste. Figure 1 &2 showed healthy growth of plants in tea wastage although it was severely affected due to the decline in protein contents ($p<0.05$) at elevated concentration of Cr^{3+} with elevated concentration of carbohydrate ($p<0.001$) and amino acid ($p<0.05$) that may be attributed with use of protein under stress and non utilization of carbohydrate whereas plants grown with tea wastage reflects the effect of tea wastage as a manure and biosorbent surface which showed inhibitory effects on the mobility of toxic metal Cr^{3+} and proves that tea wastage could be utilized to increase the soil fertility even in draft condition of toxic metals. Healthy growth in tea amended soil may also be related with the high K and P contents. Results of use of tea waste and marine green algae on the plants showed the decrease in the concentration of K contents both in root and shoot at increasing concentration of Cr and Cd compared with the control plants ($p<. 005$) which showed a dramatic affect on the plants ability to survive and functioning during metal stress periods. Initial potassium deficiency shows up as yellowing of older leaf blades, lower leaf blades, which is then followed by dieback of the leaf tip and scorching of the leaf margins as the deficiency problem becomes worse (Biddappa & Bopaiah, 1989).

Once these conditions occur, wear injury for the turf plants will increase significantly. Factors which can lead to potassium deficiency include: leaching in sandy soils or soils irrigated with the contaminated water. Many plant physiologists consider potassium second only to nitrogen in importance for plant growth. Potassium is second to nitrogen in plant tissue levels with ranges of 1 to 3% by weight. Potassium is the only essential plant nutrient that is not a constituent of any plant part. Potassium is a key nutrient in the plants tolerance to stresses (Arun *et al.*,2005). Increase in potassium contents in tea waste amended plants showed more tolerance surviving capability under various stresses, such as metals, cold/hot temperatures, drought, and wear and pest problems (Dahiya *et al.,* 2005). And both role of potassium as biophysical and biochemical were visible in this investigation. Potassium acts as catalysts for many of the enzymatic processes in the plant (Azmat *et al.*, 2010) that are necessary for plant growth to take place. Another key role of potassium is the regulation of water use in the plant (osmoregulation). This osmoregulation process affects water transport in the xylem, maintains high daily cell turgor pressure which affects carry tolerance, cell elongation for growth and most importantly it regulates the opening and closing of the stomata which affect transpirational cooling and carbon dioxide uptake for photosynthesis (Azmat *et al*.,2010). Results of tea waste amended soil showed marked effect on the plant physical and biological processes where K contents reaches to the normal value. and showed more rapid growth in soil contaminated with the Cr. Metabolic alterations by Cr^{3+} exposure and their control by solid tea wastage was already described by Azmat *et al* (2010) showed direct effect on enzymes or other metabolites or by its ability to generate reactive oxygen species which may cause oxidative stress. Increase in concentrations of the phosphorus (Azmat *et al.,* 2010) in different parts of the seedling was observed at low concentration of Cr (50ppm) which gradually lowered with an increase in concentration of Cr as compared to the control plants ($p<0.005$). It is known that P and Cr are competitive for surface sites. Hence, it is possible that Cr effectively competed with this element to gain rapid entry into the plant system. The reduction in K and P at elevated concentration could be due to the reduced root growth and impaired penetration of the roots into the soil due to Cr toxicity (Biacs *et al*., 1995). The magnitude of the content of P in tissues increased at lower concentration and its uptake decreased with increasing levels of Cr in the soil (Tsvetkova & Georgiev, 2003). It is concluded that added P alleviates the deleterious effect of Cr in the soil and improves the growth and the dry matter of shoot in been plants. Poor translocation of Cr to the shoots could be due to sequestration of most of the Cr in the vacuoles of the root cells to render it non-toxic which may be a natural toxicity response of the plant. It must be noted that Cr is a toxic and nonessential element to plants, and hence, the plants may not possess any specific mechanism of transport of Cr. The reduction in nitrogen compounds, K and P could be due to the reduced root growth and impaired penetration of the roots into the soil due to Cr toxicity (Azmat & Khanum 2005) which is successfully controlled by solid tea surface.

Results of tea waste management in the soil contaminated by industrial toxic metal clearly reflects that there should be proper research in this area is require where instead of making fertilizer from industrial waste, new technology of remediation of management of domestic waste to detoxify the industrial waste should be work out

12. Proline as an internal toxic affect manger

Proline , act as a bioindicator , an amino acid accumulated in stress to control the oxidative stress or stress manger internally in the plant. Proline increases the stress tolerance of plants through such mechanisms as osmoregulation, protection of enzymes against denaturation, and stabilization of protein synthesis (Kaushalya *et al*. 2005).Results reported in literature showed that proline contents increases with the increase in concentration of metal because for survival of plants under stress. Accumulation of proline starts under mild water stress and the magnitude of accumulation is proportional to the severity of stress (Ganesh *et al.*, 2009 ; Kaushalya *et al.,* 2005). The investigation, about the toxic metal management through tea waste or marine algae showed , higher proline content was observed at 100 ppm (0.669) of Cr and the decrease may be related with the reduced growth of plant (Fig. 1 & 2). Thus proline accumulation under such condition may also be operative as usual in osmotic adjustment while accumulation of proline in tissues can be taken as a dependent marker for stress. The higher proline content was reduced (0.039) by application of solid tea surface and plant observed normal growth under metal stress because proline has multiple functions such as osmoticum, scavenger of free radicals, protective role of cytoplasmic enzymes, source of nitrogen and carbon for post-stress growth, stabilizer of membranes, machinery for protein synthesis and a sink for energy to regulate redox potential. Proline acts as a cytoplasmic osmoticum as it accumulates to a higher degree under stress conditions, which may play an adaptive role for any stress tolerance (Vartika *et al.* 2004).

13. Enzymes activity as an environmental biomarker

Enzymes serve as the labor force to perform every single function required. Enzymes are the key to life. No enzymes, no life. Altered Enzymes activity under metal stress was successfully managed at lower concentration of metal with domestic tea wastage because an increase and decrease in the enzymes activity could reflect the current situation of environments as biomarkers (Scoccianti *et al.*, 2008).

Decrease in protease activity of *Vigna radiata* under Cr stress may be related with deficiency in phosphorus contents which may be attributed with reduce nitrogenous compounds (protein) and potassium contents of seedling due to which biophysical visual symptoms on leaves appeared like leaf growth traits that might serve as suitable bio-indicators of heavy metal pollution. Primary and trifoliate leaves of bean plants due to which Cr showed a marked decrease in leaf area; trifoliate leaves were more affected by Cr than the primary leaves (Barcelo *et al*., 1985; Dube *et al.,* 2003). Protease activity in tea waste amended plants increases which may increase the hydrolyzing capability of seedling to hydrolyze oxidative proteins for survival of plants under stress (Palma *et al*. 2002).

Observation showed that AST enzymes activity initially increases at 50ppm of Cr (589.56) as compared with the control plants ($p<0.05$) and gradually decreases with the increase in concentration of Cr. This showed that elevated concentration of Cr (III) alters the enzyme activity. Mixed tea plants showed significant effect of tea wastage as an adsorbent surface. Results of tea wastage treated plant showed that at 50 ppm, the activity of AST enzyme activity (Fig. 5) reaches approximately to the normal value (556.97) when compared with control (556.97).This reflects that Cr remediation may occur by adsorbing on the solid tea surface. But increase in the concentration of Cr showed negative effects on the AST enzymes activity. Spreaded tea waste plants showed no remarkable effects on the AST enzyme activity where continuous decrease in enzyme activity were observed which showed that for proper adsorption of heavy metal it is essential to mixed the solid tea wastage with soil thoroughly (Azmat *et al.*, 2010).

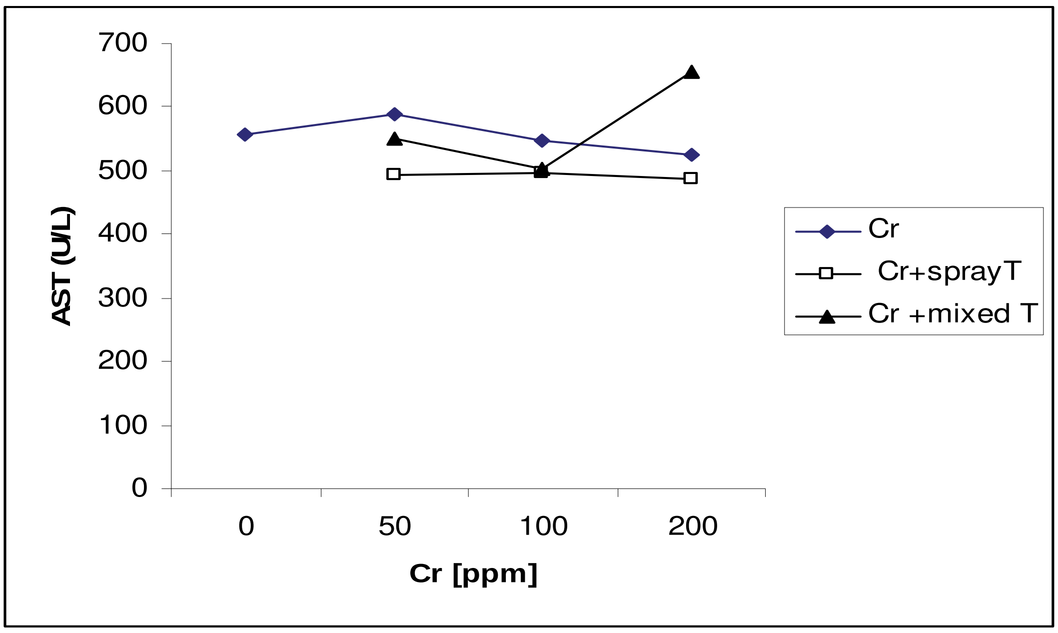

Fig. 5. Effect of Cr and solid tea wastage as a biosorbent manure on enzymes AST activity of seedlings of *Vigna radiata*

The ALT showed (Fig. 6) great variation in its activity. Initially it decreases ($p<0.001$) and then slightly increases with the elevated concentration of the Cr^{3+} i.e. 100 ppm and 200 ppm.

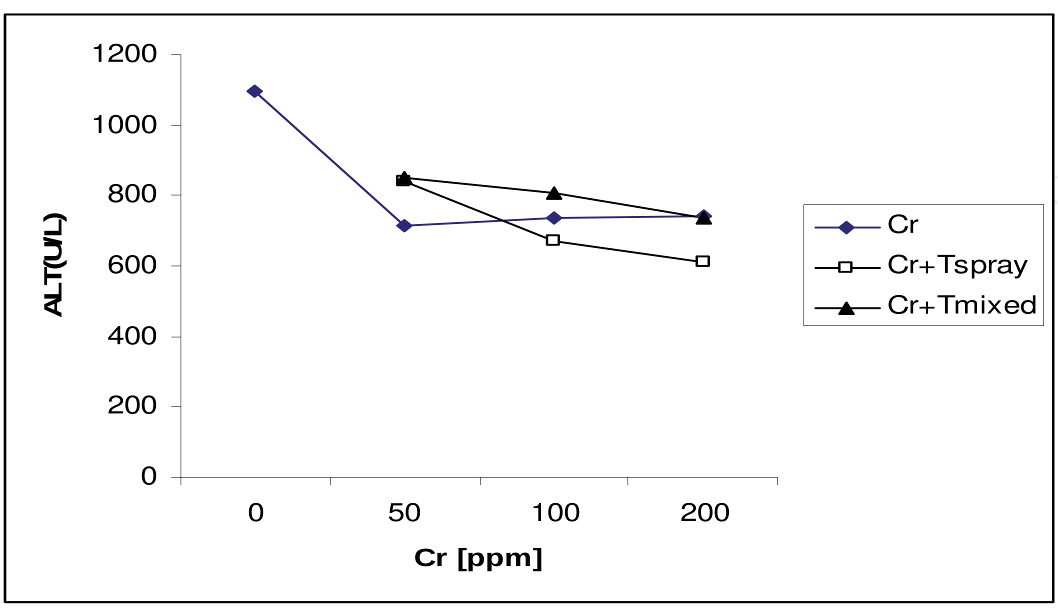

Fig. 6. Effect of Cr and solid tea wastage as a biosorbent manure on enzymes ALT activity of seedlings of *Vigna radiata*

Plants with mixed tea waste again showed slight improvement in the enzymes activity but not to that of control one. This showed that the toxicity of metal to the biomarker at higher concentration of metal.
ALP ($p<0.05$) showed completely different response to the heavy metal Cr which showed an increase in enzyme activity to overcome the heavy metal stress. This may be attributed with decrease or increase in the enzyme activity due to the denatured of site of interaction of enzymes under metal stress (Fig. 7).

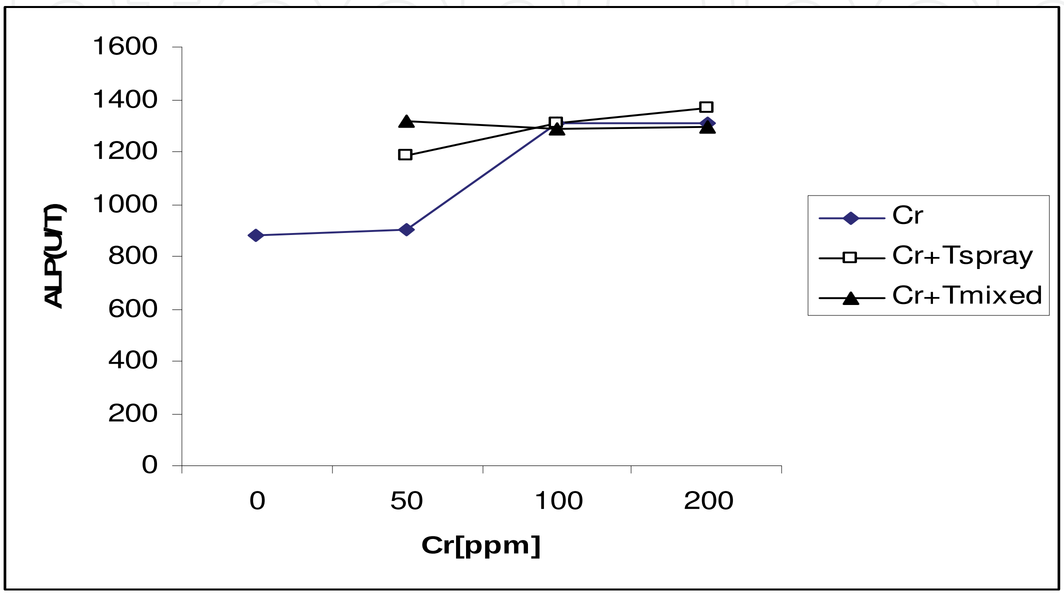

Fig. 7. Effect of Cr and solid tea wastage as a biosorbent manure on enzymes ALP activity of seedlings of *Vigna radiata*

The results of the analyses, reported hereby prove that activity of individual enzymes is quite a sufficient indicator of soil fertility. Enzymatic activity of soil is a reliable measure of current biological status. Naturally occurring amounts of heavy metals do not disturb the biochemical balance of soil. Slightly higher quantities of heavy metals might stimulate the activity of soil enzymes, whereas in larger they will have an inhibitory effect (Wyszkowska, 2002). Heavy metals, however, are regarded as inhibitors of enzymatic activity. It was observed that the potential soil fertility index decreased at higher concentration of chromium contamination and showed appreciably negative affect on the germination processes and altered the activity of enzymes correlated with chromium. It was interesting to note that the activity of two enzymes decreased up to 100 ppm level of Cr while ALP as found to be increased at all applied doses and experiments also revealed that chlorophyll a and b decrease with the concentration of Cr (Azmat *et al.*, 2005) but improved with the application of tea waste amended soil. These results showed that chlorophyll as a vital pigment for life of plants which is not tolerant to chromium and its toxicity was correlated with the degree of soil contamination. Soil amended with the solid tea wastage showed increase in concentration of chlorophyll contents. Carbohydrate contents of *Vigna radiate* showed increase in concentration which may be related with the metal toxicity and alteration in key enzymes activity of protein and carbohydrate metabolism (Azmat et al 2010). The effect of Cr(III) on the activity of AST, ALT and alkaline phosphatase depended on the rate of soil contamination with chromium. Wyszkowska (2002) reported that in the objects polluted with 100 mg Cr kg^{-1} of soil, plants became necrotic at the stage of seedlings, and in the soil treated with 150 mg Cr kg^{-1} of soil, the emergence of plants was inhibited.

14. A probable mechanism of remediation of metal within the soil

The probable mechanism of adsorption of metals like Cr ,Hg, and Cd based on complex formation with fatty acids, algainate,polysaccharides found in the algae and solid tea surface, The incorporation of these two cost effective adsorbate play a crucial role in checking the mobility of metals. It is proposed that metal in a complex state doesn't moves in the free state to accumulate in the plants through false signal to the plant growth system. The mechanism of remediation of Cr^{3+} based on adsorption of Cr^{3+} on tea solid wastage within the soil where it was found that in the pot which contained thoroughly mixed tea waste with the garden soil shows soil stony structure and the plants of this pot was quite erect and more healthy as compared to plants with $Cr^{3+}$and with no Cr^{3+}. The available biochemical experimental data offered here that plants with mixed tea showed more tolerant morphological as well as physiological parameters. The remediation mechanism for the adsorption of heavy metal Cr^{3+} using tea waste has been presented here showed that soft colloid and chemical components like palmitic acid of fatty acids group, terpenes and di-Bu phthalate play a key role for complex forming with the metals reduced the mobility of metal in the contaminated soil and reduced the accumulation of Cr^{3+} in plant tissues in the early stage of development of seedlings whereas the plants grown in a contaminated soil with seaweeds show swollen state of soil when watered and soil wet long time which indicate that seaweeds retained water in it and increases the water holding capacity which ultimately benefit to the soil under stress and supply water into the plants, results to overcome the stress which results in the better growth and clean food from every unnecessary material (Fig.8-10)

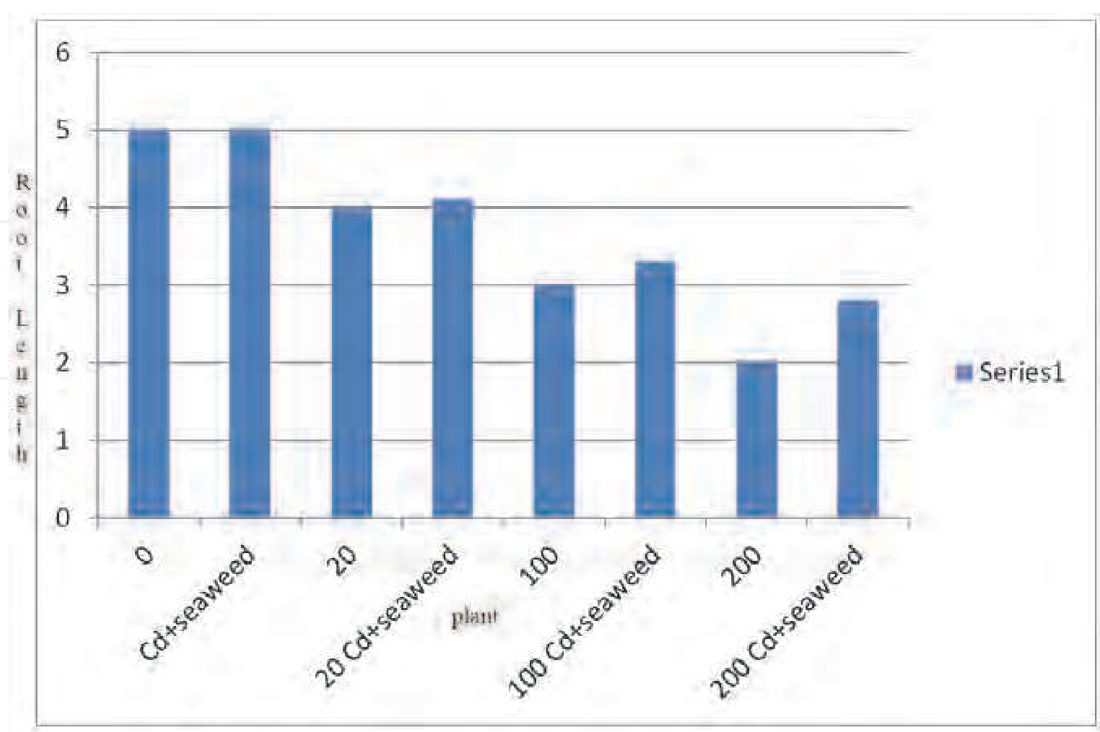

Fig. 8. Effects of seaweeds in root length of *Vigna radiata* in Cd contamination

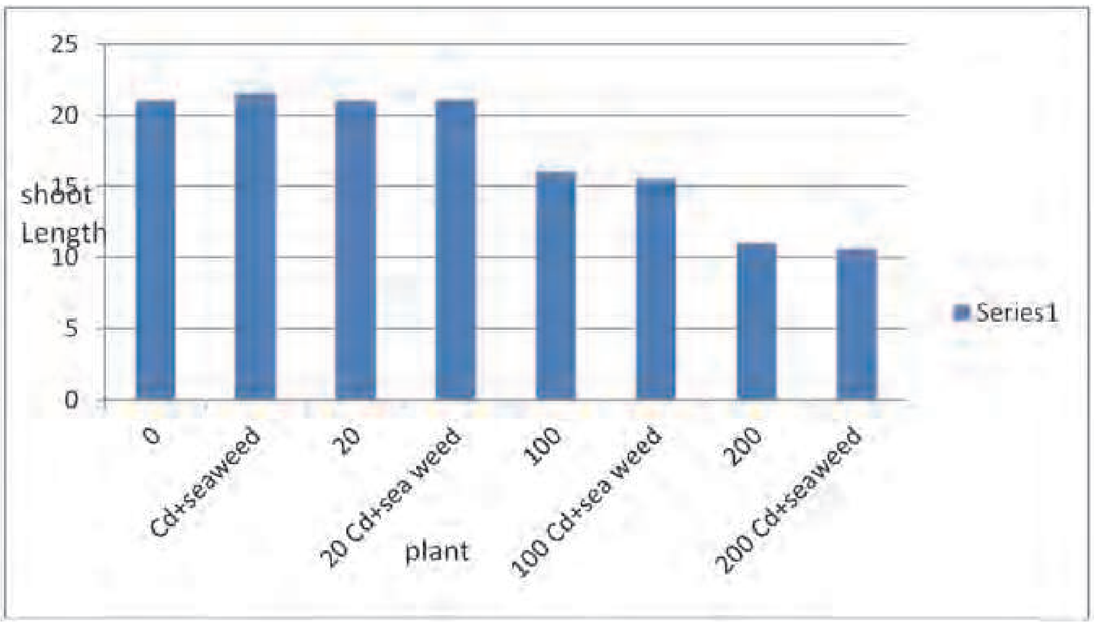

Fig. 9. Effects of seaweeds in shoot length of *Vigna radiata* in Cd contamination

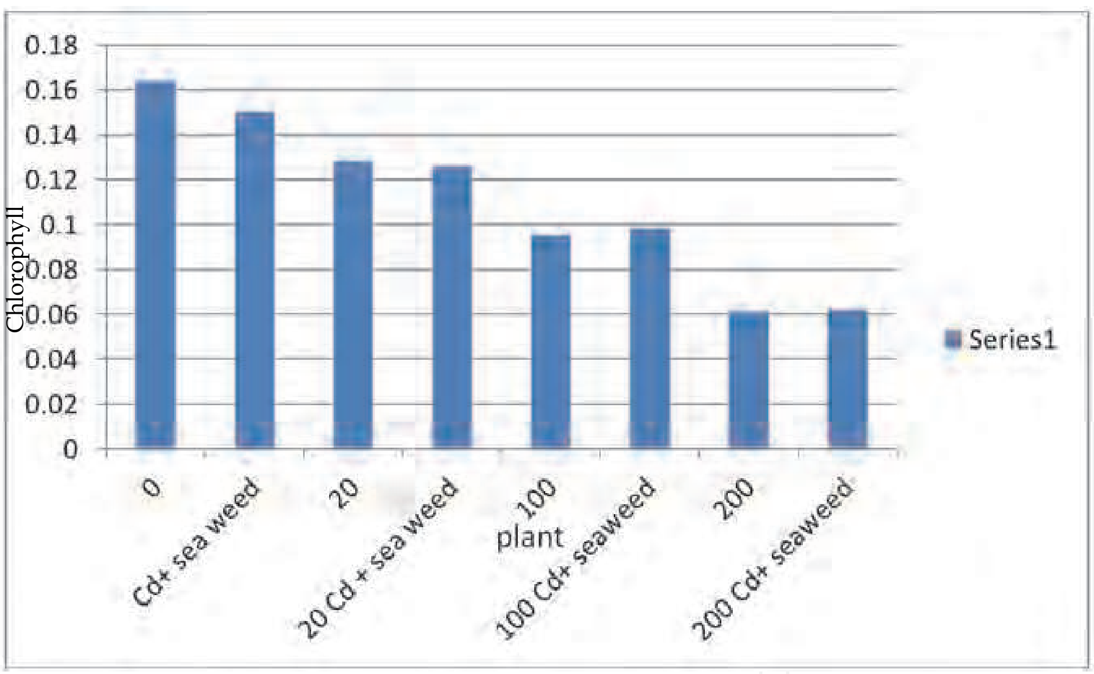

Fig. 10. Effects of seaweeds in chlorophyll content of *Vigna radiata* in Cd contamination

These topics require further researches in the field of biosorption and new technologies of remediation of one wastage with others toxic waste.

15. Mechanism of complexation

The biosorption of metals (**Ahalya et al 2005**) take place through both adsorption and formation of coordination bonds between metals and amino and carboxyl groups of cell wall polysacchonides of seaweeds. The metal removal from sewage sludge may also take

place by complex formation on the cell surface after the interaction between the metal and the active groups of proteins and amino acids found in green algae. Complexation was found to be only mechanism responsible for calcium, magnesium, cadmium, zinc, copper and mercury accumulation by marine algae.
Investigation showed that application of dry seaweed powder to the sludge provides multiple levels of potential benefits. These potential benefits have been identified during seaweed spray including nutritional level, physiological process, morphology, mineral and metal ion (Schiewer and Wong; 2000) uptake by Plants . The physico-chemical interaction occurs between the toxic metal and the surface polysaccharides of the biomass (algae}, ion – exchange, complexation and adsorption takes place and the phenomena is not metabolism dependent (Fig.1-4). The surface of the seaweeds is constituted of polysaccharides and proteins that provide a wide range of ligands for heavy metal ions. These processes are rapid and reversible. Seaweed contains all known trace element and these elements can be made available to plant by chelating i-e by combining the mineral ion with organic molecules. Starches, sugars and carbohydrates in seaweed and seaweed products possess such chelating properties (Ahalya et al 2005). As a result, these constituents are in natural combination with the iron, cobalt, copper, manganese Zinc and other trace elements found naturally in seaweed. That is why these trace elements in seaweed product do not settle out in alkaline soils, but remain available to plant, at the time of need. Fig. (4) showed that when seaweeds mixed with the sludge, biosorption of toxic metals takes place, which stimulate the growth rate and physiological processes (Azmat *et al* 2007 & Azmat *et al* 2006).

16. Conclusion

Today's industrial world has contaminated our soil, sediments and aquatic resources with hazardous material. Metal water is often resulting of industrial activities, such as mining, refining, and electroplating, Hg, Pb, As, Cd and Cr are often prevalent at highly contaminated sites. Therefore it is our responsibility to check and develop the low cost techniques to remove the toxic metals by methylation, complexation or changes in valance state from the environments for humanity. Domestic waste is generated as consequences of household activities such as the cleaning, cooking, repairing empty containers, packaging, huge use of plastic carry bags. Many times these waste gets mixed with biomedical waste from hospitals and clinics. There is no system of segregation of organic, inorganic and recyclable wastes at the household level. Improper handling and management of domestic waste from households are causing adverse effect on the public at large scale and this deteriorates the environment. Segregation of this different type of waste is essential for safety of the environment because the improper management and lack of disposal technique of the domestic waste pollutes to the environment. It affects the aquatic resources. It also changes the physical, chemical and biological properties of the water bodies. Uncollected waste is scattered everywhere and reaches to the water bodies through run-off as well as it percolate to underground water. The toxics contain in the waste, contaminates water. It also makes soil infertile and decrease the agricultural productivity. Few researches on laboratory scale cannot give the proper use of such a big hazard. It should be duty of all citizen to disposed the waste in separate begs to keep the environment safe for their lives from spread domestic wastage because dispersed uncollected waste and improper disposal techniques drains also get clogged which lead to mosquitoes by which various diseases like malaria, chicken-guinea, viral fever, dengue etc. arise and affect the health of people adversely. The

lack of literacy programmes on waste management and disposal techniques which keeps the most of the people ignorant about waste management. This lack of awareness among the people increases the problems. With the growing population the huge waste is being generated day by day. There is wide use of plastics, advanced technology and other materialistic things. This resulted in different characteristics of waste which became complicated problem for management of domestic waste and disposal techniques. This is such a burning problem concerned with environment that needs to be carefully studied and researched, as on every street waste is lying uncollected scattered around local bins and dumped around locality consequently there is occurrence of bad smell as well as hazard to the human health and to the passerby.
Research based on removal of toxic metals by marine algae and tea wastage require further investigations on domestic wastage to keep clean the environment with public environmental education.

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- Time Magazine: Evolution by Pollution
- Young People's Trust for the Environment:Endangered Wildlife
- National Geographic: Acid Rain
- Agency for Toxic Substances and Disease: ToxFAQs™ for Polycyclic Aromatic Hydrocarbons (PAHs) Registry:
- National Geographic: Toxic Waste

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Factory Farming: Toxic Waste and Fertilizer in the United States, 1990-1995," Environmental Working Group, 1998. 2) In addition to California, Georgia, Idaho, Indiana, Michigan, Minnesota, Montana, North Carolina, Pennsylvania, Texas, Virginia, and Washington states, the tested fertilizers (See Appendix B) are available in many other states. This is especially true for home and garden fertilizers like Scotts.3) 40 CFR 266.20, 40 CFR 268.40 (i) 4) Zinc fertilizers are subject to less stringent Phase III Land Disposal Restrictions, which do not include beryllium and vanadium. Zinc fertilizers made from electric arc furnace dust (K061) are not subject to standards. 40 CFR Part 268, [FRL-6153-2], RIN 2050-AE05, EPA, 1998. 5) "Visualizing Zero: Eliminating Persistent Pollution in Washington State." Washington Toxics Coalition, 2000.6) Wilson, D., "Fear in the Fields," The Seattle Times, July 3, 1997, citing Agency for Toxic Substances Disease Registry, EPA. 7) www.pirg.org /enviro/index.htm 8) National Water Quality Inventory: 1998 Report to Congress (EPA841-R-00-001) 9) 40 CFR 266.20 and 40 CFR 268.40 (i) 10) The exception is K061 (the waste code for electric arc furnace dust produced by steel mills) which are not sunject to regulation. 11) Non-zinc fertilizers are subject to Universal Treatment Standards, 40 CFR 268.48 12) http://www.epa.gov/epaoswer/hazwaste/recycle/fertiliz/index.htm13) Environmental Protection Agency, EPA530-F-99-043, December 1999.

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This book reports mostly on institutional arrangements under policy and legal issues, composting and vermicomposting of solid waste under processing aspects, electrical and electronic waste under industrial waste category, application of GIS and LCA in waste management, and there are also several research papers relating to GHG emission from dumpsites.