Chapter 15

FUTURE SCOPE OF RESEARCH
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Based on the available information from the literature as well as results inferred from the present investigation the following scope of research have been identified which might be taken up in future on a priority basis.

1. The first line of future research would be to continue efforts to develop an understanding of the important humic acid structures involved in metal complexation. This would lead to better modeling of metal complexation as well as methods to evaluate the metal binding potential of specific humic acids, important in development of risk assessment scenarios and remediation efforts. The examination of several different types of humic acids, such as a peat, lignite or soil derived humic acid, which may have metal binding sites that differ from each other would indicate how homologous the metal binding sites are for natural organic matter.

2. Research involving humic acid can be quite complex due to the heterogeneous nature of the humic material itself. However, increased knowledge of the mechanisms of sorption of contaminants to humic material and the factors affecting these mechanisms will lead to the creation of predictive models for environmental remediation processes.

3. Comparative evaluation of the binding coefficients by different techniques for major environmental pollutants such as heavy metals at varying pH values, ionic strength and humic acid concentration to rigorously predict the effect of pH, ionic strength and humic acid concentration on the complexation of metals by humic acid.

4. Further investigation on the competition between different metals for specific binding sites in humic substances by performing additional experiments at high metal concentration and different techniques.

5. Probe in detail the size and micro-structural changes of the pores of humic acid on metal complexation.
6. Systematically investigate the effect of humic acid on the adsorption/desorption of metal ions on suspended particles and agglomeration or coagulation processes of suspended or colloid particles as a function of the molecular weight of humic acid.

7. Very limited research has been carried out nation-wide on the use of humic acid as potential substance for remediation of heavy metal polluted soils. An attempt has been made in the present investigation to study the effective remediation power of humic acid on detoxification of heavy metal contaminated soil of Dhapa area located at Kolkata, West Bengal, India through both field and pot experiments. However, in future, an attempt should be made to extend such field experiments throughout the country.

8. In the present investigation only DTPA and Olsen-extractable heavy metals have been studied. But other forms such as crystalline, amorphous, organic bound, sesquioxide bound exist in dynamic equilibrium in soils and affect their availability to plants. The different forms and fractions should therefore be taken into account.

9. The effect of humic acid on heavy metals should be evaluated for more than one growing season and their residual effect should be taken into account.

10. In the present study only rice and maize have been considered. Therefore, in future some vegetable crops are to be undertaken on priority basis.

11. Although the use of commercial humic acids in this work was effective for the investigation of the importance of structural differences in humic acids, the applicability of these commercial humic acids to natural humic acids is questionable.

12. Comparative evaluation of effectiveness of humic acid with other soil conditioner, biosolids in remediation of heavy metal polluted soil along with their cost benefit ratio are to be carried out.

13. There have been a large number of observations indicating humic acid can influence nutrient uptake by plants and increase crop yields significantly. Use of humic acid either native or exogenous together with inorganic fertilizers to maximize plant nutrient uptake and final yields may have tremendous impact in both increasing the economic efficiency of fertilizers and protecting the environment from pollution of excess fertilization.