Arsenic is a potential toxin that can enter the environment in elevated levels naturally and as a result of anthropogenic activities. Arsenic concentrations in drinking water supplies throughout the world, e.g., in Bangladesh have exceeded the As standard level (50μgL⁻¹).

As (III) is usually considered to be more toxic than As (V) and the presence of As (III) and As (V) in different proportions in water supplies may produce different toxic effects therefore, measurement of total arsenic concentration is insufficient to assess the risk of As exposure in human populations. Studies of As speciation and transformations among species are essential to understanding the As behavior in the environment.

Arsenic sorption, bioavailability and behavior in natural systems are largely controlled by amorphous and crystalline Fe, Al and Mn hydroxides.

Arsenic toxicity, mobility and bioavailability in soil water systems are highly dependent on its oxidation states and chemical species.

In soils and natural waters, inorganic arsenic is usually found in the form of arsenite [As(III)] or arsenate, [As(V)]. Since As (III) is less strongly sorbed than As (V) to a variety of sorbents, arsenic is generally more mobile in this form, and immobilization of arsenic is enhanced by the oxidation of As (III) to As (V).

Synthetic goethite (α-FeOOH) has been selected as a model substrate for arsenate and arsenite adsorption principally because it can be synthesized under precisely controlled condition as regular, well formed, small crystals of large surface area. The
adsorption/desorption of As is also very sensitive to pH and Eh conditions. Rates of arsenic mobilization during reduction in soils are highly dependent on oxide surface area and arsenic surface coverage. Three different surface complexes exist on goethite for arsenate a monodentate and bidentate complexes at intermediate coverage, and predominantly the bidentate - binuclear complexes at very high coverage.

Application of phosphate fertilizers has been shown to affect the mobility of arsenic in soils and the excess of phosphate has been used to displacement As (III) or As (V) from sediments, fly ash, and soil, but the displacement is slow and often incomplete.

Cadmium (Cd) is one of the toxic trace metals, which can be introduced into and accumulate in soils through agricultural application of sewage sludge and fertilizers, and / or through land disposal of metal – contaminated municipal and industrial wastes.

Chemical processes strongly affect the fate and availability of Cd in soils. Concentrations of heavy metals including Cd in soil solution are most likely controlled by sorption – desorption reactions on the surface of soil colloidal materials.

As major components of soil colloidal materials, iron and manganese oxides play very important roles in the sorption of heavy metals. Goethite is the widest spread iron oxide in natural environments, and has been well studied and used for sorption experiments.

Previous studies indicate that desorption is as important as sorption, because it governs the rate and extent of metal ions released from sorbents.
Improved understanding of desorption characteristics may allow the scientists to better evaluate the bioavailability and potential toxicity of trace metals in soils. However, compared with adsorption research, desorption of heavy metals received relatively limited attention.

**The objectives of this research were to:**

(i) survey As and Cd contents in soils and waters, (ii) study the adsorption isotherms of arsenic and cadmium by two soils (varied in their texture and calcium carbonate content), zerovalent iron, and synthetic mineral (goethite), (iii) investigate the effect of pH on adsorption and desorption of As and Cd from some adsorbent materials, (iv) assess the competitive adsorption of (As,Se),(As,S),(As,P),(As,Mo) and (Cd,Co) on the tested materials and (v) study the adsorption kinetics of As on the goethite and zerovalent iron.