Estimation of biochar efficiency for the removal of cadmium, lead, and chromium from the coal waste-contaminated soil in Dara Adamkhel

Tahir Sattar[1*], Rahib Hussain[1,2**], Shehla Sattar[3], Shahid Malik[1], Sarfa Aslam[1], Tasbiha Khan[1], Naeem Ur Rehman[1], and Bushra Zia Khan[1]

[1]*College of Earth & Environ. Sciences, University of the Punjab, Lahore, Pakistan*

[2]*Sustainable Development Study Centre, GC College University, Lahore, Pakistan*

[3]*Department of Environmental Sciences, University of Swabi, Swabi, Pakistan*

*Email: *tahirsattar725@gmail.com/ **dr.rahib@gcu.edu.pk/ rahibpcr@gmail.com*

In Dara Adamkhel coalfield releases a huge amount of coal waste including coal gangue, coal slime, rocks, and soil, which is comprised of toxic trace elements and may cause diverse issues in the local environment. The current study was carried out for the investigation of pollutants deposited in soil, originating from the coalmines present in that study area, and its effects on crops specifically Corn and Lettuce, grown in the polluted soil. Near the coalmines, the soil usually contains harmful metals and substances transported by the runoff coming through the coalmines. The area near the coalmines is more prone to contamination. A total of 40 soil samples were collected from Dara Adamkhel for examining the toxic trace elements (TTE) such as Cd, Cr, and Pb. For the remediation of trace elements, pot experiments were applied for cultivating 20 corn and 20 lettuce samples in the contaminated soil. Afterward, these samples were treated with activated pyrolyzed biochar to limit the mobility and adsorption of toxic trace elements. To investigate the toxic trace metals, the soil was treated with acid and determined through an atomic absorption spectrophotometer (AAS). Before treatment, the average concentration (mg/kg) of Cr in soil was 47.71 ±20.4, Cd 5.86 ±2.1, and Pb 69.57 ±31.7. Conversely, after treatment, imposition of Cr was 20.72 ±8.5, Cd 3.37 ±1.2, and Pb 7.01 ±3.19 in mg/kg, while the average minimization of Cd, Cr, and Pb was up to 43 % Cr, 57% Cd, and 94% Pb through biochar application in Corn pots. Whereas, for the lettuce experiments, the minimization was 42% of

Cr, 76% of Cd, and 73% of Pb. The biochar application, in Corn and Lettuce crops was effective for the minimization of toxic elements in coal waste-contaminated soil. The trace element averages for Cr, Cd, and Pb in the Lettuce Crop pots were 47.65, 5.42, and 14.87 mg/kg respectively. In Corn Soil, Pb had the highest quantity followed by Cd and Cu before and after treatment. Lettuce Soil however exhibited the highest levels of Cr in samples that were cleaned. There was also a similar variation in elemental concentrations, which were lower than all other literature studies carried out to date. In the Corn pots before treatment, the trends of trace elements in the soil were Pb > Cr > Cd, while after treatment were Cr > Pb > Cd. Cr > Pb > Cd was signified in both contaminated and treated soil of Lettuce. It was found that Corn and Lettuce crops coupled with biochar had the potential to decrease the quantity of toxic elements from coalmine spoiled soil at an optimum level. The present study provides insights to using wood biochar for the rehabilitation of coal waste-contaminated soil. Whereas, its enviro-health effects on the surroundings cannot be undermined. The use of activated biochar limits the mobility of toxic trace elements as well as health effects.