To attain sustainable development in agriculture, management of vegetation, soil and water resources should be done in an integrated and rational manner. Agriculture alone cannot uplift the economic scenario of a region but must be supplemented by other minor and major industries. While pursuing industrial activities, it should be taken into account that the congenial environment should not be deteriorated as environmental degradation ultimately leads to reduction in production and productivity of crops.

Jaintia Hills district is situated in the eastern part of the state of Meghalaya and lies between 25°5' to 25°4' N latitudes and between 91°51' to 92°45' E longitudes. Majority of the population of the district depends on agriculture as the source of livelihood. There is a wide range of cropping systems in the district, of which rice based cropping system is dominant.
Next to agriculture, coal mining is the major industrial source of income in Jaintia Hills district of Meghalaya. A sizable amount of population is involved in the process of mining activity. Sutnga, Lakadong, Musiang-Lamare, Khliehriat, loksi, Ladrymbai, Rymbai, Byrwai, Chyrmang, Bapung, Jarain, Shkentalang, Lumshnong, Sakynphor etc. are the main coal mining areas of the Jaintia Hills.

It has been observed that coal mining activities in the area is unscientific, unsystematic and primitive in nature. Extraction of coal is carried out by a primitive mining method commonly known as ‘rat-hole’ mining. Many researchers have reported that deforestation, soil erosion, surface run-off, caving in of the ground and pollution of land, air and water are some of the prominent environmental problems associated with coal mining in the area. The mining activity has also deteriorated the soil quality of the area. As a consequence, many farmers have abandoned the farming activity. Agricultural fields have been adversely affected by acidification of soil as well as by deposition of coal and sand particles on soil surface. Significant increase in soil acidity has negative impact on soil fertility, biological activity and plant productivity.

The availability of the essential nutrients to the plant becomes restricted in highly acidic soil condition and the process of mineralization is also affected because of the diminished microbial activity, mostly bacterial activities in acidic...
soils. Further, acidity contributes to the build up of detrimental heavy metal concentration in agricultural fields, which ultimately enters in to the biological system through the crops grown in the affected fields.

Rice is the major agricultural crop grown in Jaintia Hills district followed by maize, potato, minor cereals, oilseed crops and vegetables. As the fertility status of crop fields are deteriorating due to both physical and chemical degradation caused by bi-products of coal mining areas including Acid Mine Drainage (AMD), it was felt to evaluate the overall scenario of agricultural production in Jaintia Hills district and to find out some remedial measures so that the crop sustainability can be maintained by improving the existing situations and farmers of the area can earn better economic return from their agriculture.

Thus, considering the seriousness of the problem, present study has been undertaken to assess the effects of coal mining on agriculture and on soil quality in Jaintia Hills district of Meghalaya. Physico-chemical analysis of soils collected from rice fields of three different coal mining sites of Jaintia Hills district, Meghalaya namely Dkhiah, Lad Rymbai and Bapung was done. In order to improve the quality, soils were treated with lime and organic matter (Farm Yard Manure) to see their effects on various soil properties. A pot culture experiment was conducted with soils collected from Bapung area during kharif
seasons of 2005 and 2006. Various treatments comprised of control, lime (72.9 g/pot), Farm Yard Manure (178.6 g/pot) and lime (72.9 g/pot) + Farm Yard Manure (178.6 g/pot). The responses of three different rice varieties to various treatments applied were quantified through various plant parameters such as phenology, plant height (cm), Leaf Area Index, dry biomass (g/plant), number of effective tillers/plant, number of grains per panicle, grain weight per plant (g/plant), grain yield (kg/ha) and Harvest Index (HI). Statistical analyses were performed following standard procedures (Gomez, 1984). The results of the study have been summarized as follows:

1. A considerable proportion (31.57%) of total geographical area is under 'cultivable wasteland' which is much higher than total cropped area (8.64%). Rate of increase of net sown area was much slower (1.86%) as compared to 'area under non agricultural uses' (5.23%) during the period from 1987-88 to 2001-2002.

2. Rice is the major agricultural crop grown in Jaintia Hills occupying about 50.5% of net sown area in the district. There was overall decrease of rice area (-0.83%) in the district since 1987-88 till 2001-02. The increase of rice yield in 2001-02 in comparison to 1987-88 was only 381.8 Kg/ha, which is very meager in a span of 15 years. Though Jaintia Hills occupies second
position in area under rice (16,102 ha) but its yield is much lower (1139.8 kg/ha) in comparison to the other districts of Meghalaya.

3. Physico-chemical analysis of soils collected from rice fields of three different coal mining sites of Jaintia Hills district, Meghalaya namely Dkhiah, Lad Rymbai and Bapung revealed that soils were having highest percentage of sand (60-63%) followed by silt (18-21%) and clay (17-20%). Further soils were highly acidic (pH 3.3-4.1) with medium availability of N (94.08-110.46 ppm), P (4.20-6.48 ppm), K (54.02-78.17 ppm) and organic carbon (0.21 - 0.67%). Soil pH, organic carbon and available nutrients of soils of all the coal mining sites of Jaintia Hills were lower than the soil of unmined site of the district. Soil collected from Bapung was having lowest pH (3.3) along with lowest levels of N (94.08 ppm), P (4.20 ppm), K (54.02 ppm) and organic C (0.21%) among three different coal mining sites.

4. To improve the quality of soil, the collected soils (Bapung) were treated with lime (72.9 g/pot), Farm Yard Manure (178.6 g/pot) and lime (72.9 g/pot) + Farm Yard manure (178.6 g/pot). It was found that (a) Application of lime enhanced soil pH up to 6.0; (b) Application of Farm Yard Manure increased soil pH to a level of 4.7; (c) Application of lime + Farm Yard Manure increased soil pH to a level of 6.2 and (d) Highest organic carbon (4.05%) was recorded due to application of both Farm Yard Manure and lime.
5. Application of organic matter increased the availability of nitrogen (N), phosphorous (P) and potassium (K) to the levels of 128.99, 7.17 and 97.05 ppm, respectively as compared to 118.22, 5.51 and 81.97 ppm, respectively due to application of lime. Highest availability of nutrients (139.47 ppm N, 10.15 ppm P and 111.03 ppm K) were recorded after combined application of both lime and Farm Yard Manure.

6. Three varieties of rice namely Khaw Shaw, Bhalum-1 and Bhalum-2 were used for varietal trial under different treatments i.e. lime, Farm Yard Manure and their combination. The study revealed that:

(a) The local variety (Khaw Shaw) exhibited a total duration 152 days for completing its life cycle. On the other hand both Bhalum-1 and Bhalum-2 completed their life cycles by 126 and 127 days, respectively. Treatments with lime and Farm Yard Manure reduced the number of days to attain different phenological stages of Khaw Shaw.

(b) Mean plant height attained at maturity stage for Bhalum-2 was highest (102.7 cm) followed by Bhalum-1 (100.1 cm) and Khaw Shaw (99.4 cm). Maximum plant heights observed were 104.9 cm, 105.3 cm and 107.6 cm, respectively for Khaw Shaw, Bhalum-1 and Bhalum-2 under treatment with both lime and Farm Yard Manure.
(c) Within the different rice varieties no statistically significant difference in Leaf Area Index (LAI) was found. The mean LAI recorded in case of Khaw Shaw (1.41) was higher than Bhalum-1 (1.16) and Bhalum-2 (1.39). Maximum LAI was 1.84 for Khaw Shaw under treatment with both lime and Farm Yard Manure. In case of Bhalum-1, maximum LAI recorded was 1.44 under treatment with lime. Again, Bhalum-2 showed maximum LAI of 1.61 under treatment with Farm Yard Manure.

(d) Total dry biomass produced by Khaw Shaw was 76.37 and 60.56 g/plant higher than Bhalum-1 and Bhalum-2, respectively. Again Bhalum-2 yielded 15.86 g/plant higher dry biomass than Bhalum-1. Maximum dry biomass recorded were 153.58, 74.48 and 83.37 g/plant, respectively under treatment with both lime and Farm Yard Manure.

(e) Mean number of effective tillers per plant produced by Bhalum-2 (11.87) and Bhalum-1 (11.75) were higher than number of effective tillers produced by Khaw Shaw (9.08). Maximum number of effective tillers per plant recorded were 11.3, 12.2 and 12.7, respectively for Khaw Shaw, Bhalum-1 and Bhalum-2 under treatment with both lime and Farm Yard Manure.

(f) Bhalum-2 produced significantly higher number of grains per panicle (77.58) as compared to Bhalum-1 (69.4 nos.) and Khaw Shaw (62.9 nos.).
Maximum number of grains per panicle recorded were 69.7, 81.0 and 91.0 for Khaw Shaw, Bhalum-1 and Bhalum-2, respectively under treatment with both lime and Farm Yard Manure.

(g) Grain yield of Bhalum-2 was highest (22.44 g/plant) followed by Bhalum-1 (18.41 g/plant) and Khaw Shaw (13.46 g/plant). Highest grain yields recorded were 19.59, 25.29 and 30.05 g/plant for Khaw Shaw, Bhalum-1 and Bhalum-2, respectively under treatment with both FYM and lime.

(h) Harvest Index (HI) of Bhalum-1 was higher (0.372) as compared with Bhalum-2 (0.351) and Khaw Shaw (0.098). Maximum Harvest Indices recorded were 0.13 and 0.37, respectively for Khaw Shaw and Bhalum-1 under the treatment of both FYM and lime. However, maximum HI recorded for Bhalum-1 was 0.44 under treatment with Farm Yard Manure.

(i) On the basis of the standard statistical analysis of different growth and yield parameters, the three tested rice varieties were ranked according to their performances. Three ranks viz. 1, 2 and 3 were assigned to the varieties pertaining to any given parameter depending on their recorded level in descending order of magnitude. After proper ranking of the rice varieties, it has been observed that the variety Bhalum-2 ranked first in highest number of recorded plant parameters followed by Bhalum-1 and Khaw Shaw.
From the present investigation, it can be concluded that utilization of both Farm Yard Manure (10 tonnes/ha) and lime (4.08 tonnes/ha) would improve soil fertility for cultivation of rice in highly acidic soil of coal mining areas of Jaintia Hills district, Meghalaya. Further, cultivation of the rice variety, Bhalum-2 (RCPL-1-29) would fetch higher yield as compared to traditional low yielding variety Khaw Shaw in coal mining areas.