PIPARWAR OCP

2013-14

Land Restoration / Reclamation Monitoring of more than 5 million cu. m. (Coal + OB) Capacity Open Cast Coal Mines of Central Coalfields Limited Based on Satellite Data for the Year 2013

ASHOK & PIPARWAR OCPs CCL

Submitted to:

Central Coalfields Limited
Ranchi, Jharkhand

Land Restoration / Reclamation Monitoring of more than 5 million cu. m. (Coal + OB) capacity Open Cast Coal Mines of Central Coalfields Limited Based on Satellite Data for the Year 2013

March-2014

Remote Sensing Cell
Geomatics Division
CMPDI, Ranchi

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Executive Summary

1.0	Project	Land restoration / reclamation monitoring of 5 opencast coal mines of Central Coalfields Ltd. (CCL) producing more than 5 million cu. m. (Coal + OB) per year based on satellite data, regularly on annual basis.
2.0	Objective	Objective of the land restoration / reclamation monitoring is to assess the area of backfilled, plantation, social forestry, active mining area, water bodies, and distribution of wasteland, agricultural land and forest in the leasehold area of the project. This will help in assessing the progressive status of mined land reclamation and to take up remedial measures, if any, required for environmental protection.

3.0   Salient Findings

- Out of the total mine leasehold area of 48.47 Km^2 of the 5 OC projects viz. Ashok, Piparwar, KD Hesalong, Parej East and Rajrappa considered for monitoring during year 2013-14; total excavated area is only 26.08Km^2 (53.81% of lease area) of which 15.68 Km^2 area (60.12%) has been planted, 5.43 Km^2 area (20.82%) has been backfilled and 4.97 Km^2 area (19.06%) is under active mining. It is seen from the analysis that 80.94% areas of the OC projects have already been reclaimed and balance 19.06% area is under active mining. Project wise details are given in Table-1 & Fig -1.

- On comparing the status of land reclamation carried out in year 2013 with respect to year 2012 in different projects, it is seen that area of land reclamation has increased from 20.63 Km^2 (Yr.2012) to 21.11 Km^2 (Yr.2013). Area of plantation has decreased from 16.33 Km^2 (Yr.2012) to 15.68 Km^2 (Yr.2013) due to the felling of trees in social forestry areas for mining & allied purposes. Details are given in Table-2.

- Area of biological reclamation (plantation) has reached 15.68 Km^2 as a result of measures taken by the company CCL, towards environmental protection.

Table - 1

Projectwise Land Reclamation Status in Opencast Projects of CCL
based on Satellite Data of the year 2013

% Calculated in terms of Total Excaveted Area (Area in Sq. Km)

Sl. No.	Project Name	Leasehold (i) 2012	Leasehold (i) 2013	Plantation/ Vegetation ii 2012	Plantation/ Vegetation ii 2013	Under Backfilling iii 2012	Under Backfilling iii 2013	Under Active Mining iv 2012	Under Active Mining iv 2013	Total Excavated Area ii+iii+iv 2012	Total Excavated Area ii+iii+iv 2013	Total Area under Reclamation ii+iii 2012	Total Area under Reclamation ii+iii 2013
1	ASHOK *	5.42	6.75	1.32	1.30	0.49	0.92	1.38	0.92	3.19	3.14	1.81	2.22
				41.38	*41.40*	*15.36*	*29.30*	*43.26*	*29.30*			*56.74*	*70.70*
2	PIPARWAR #	11.20	11.20	5.64	5.03	0.57	0.87	2.03	1.82	8.24	7.72	6.21	5.90
				68.45	*65.16*	*6.92*	*11.27*	*24.64*	*23.58*			*75.36*	*76.42*
3	KDH	4.50	4.50	1.45	1.45	0.81	1.18	0.35	0.55	2.61	3.18	2.26	2.63
				55.56	*45.60*	*31.03*	*37.11*	*13.41*	*17.30*			*86.59*	*82.70*
4	PAREJ EAST	6.20	6.20	0.55	0.60	0.51	0.76	0.60	0.51	1.66	1.87	1.06	1.36
				33.13	*32.09*	*30.72*	*40.64*	*36.14*	*27.27*			*63.86*	*72.73*
5	RAJRAPPA	19.82	19.82	7.37	7.30	1.92	1.70	0.34	1.17	9.63	10.17	9.29	9.00
				76.53	*71.78*	*19.94*	*16.72*	*3.53*	*11.50*			*96.47*	*88.50*
	TOTAL (CCL)	47.14	48.47	16.33	15.68	4.30	5.43	4.70	4.97	25.33	26.08	20.63	21.11
				64.47	*60.12*	*16.98*	*20.82*	*18.56*	*19.06*	*52.26*	*53.81*	*81.44*	*80.94*

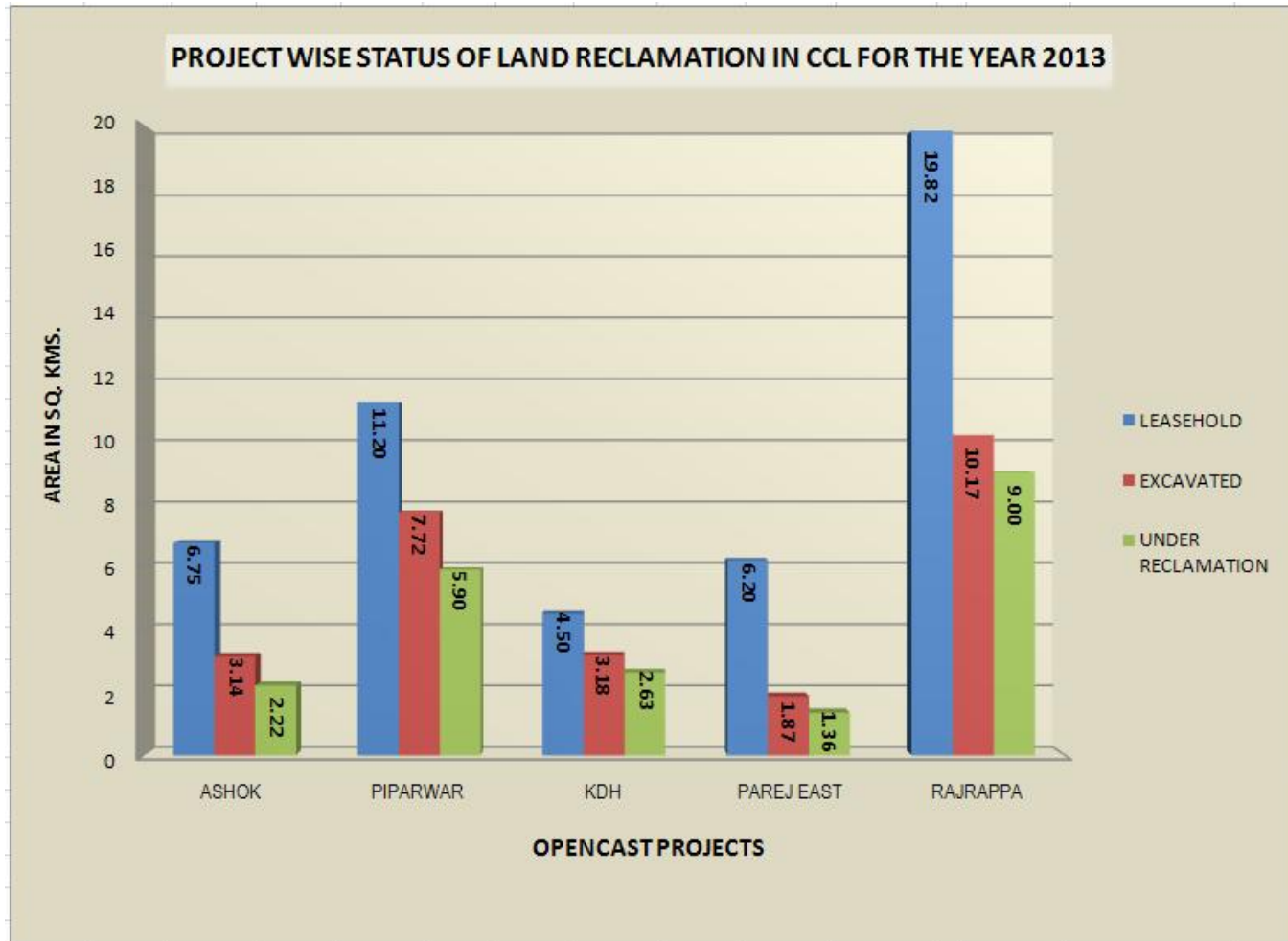** Lease hold area of Ashok OCP has been modified by CCL*

Fig. 1 : **Project wise Land Reclamation Status in Year 2013-14**

1.0 Background

1.1 Land is the most important natural resource which embodies soil, water, flora, fauna and total ecosystem. All human activities are based on the land which is the scarcest natural resource in our country. Mining is a site specific industry and it could not be shifted anywhere else from the location where mineral occurs. It is a fact that surface mining activities do effect the land environment due to ground breaking. Therefore, there is an urgent need to reclaim and restore the mined out land for its productive use for sustainable development of mining. This will not only mitigate environmental degradation, but would also help in creating a more congenial environment for land acquisition by coal companies in future.

1.2 Keeping above in view, Coal India Ltd. (CIL) issued a work order vide letter no. CIL/WBP/Env./2011 dated 12.10.2012 to Central Mine Planning & Design Institute (CMPDI), Ranchi, for monitoring land reclamation status of all the opencast coal mines having production of more than 5 million m^3 per annum (coal + OB taken together per annum) regularly on annual basis, and for monitoring of less than 5 million m^3 per annum capacity (Coal +OB) projects at an interval of three years based on remote sensing satellite data, for sustainable development of mining. The result of land reclamation status of all such mines is to be put on the website of **CIL**, (www.coalindia.in), **CMPDI** (www.cmpdi.co.in) and the concerned coal companies in public domain. Detailed report is to be submitted to Coal India and respective subsidiaries.

1.3 Land reclamation monitoring of all open cast coal mining projects would also comply the statutory requirements of Ministry of Environment & Forest (MoEF).Such monitoring would not only facilitate in taking timely mitigation measures against

environmental degradation, but would also enable coal companies to utilize the reclaimed land for larger socio-economic benefits in a planned way.

1.4   Present report is embodying the finding of the study based on satellite data of the year 2013 carried out for 5 no of OC projects of capacity more than 5 mcm (coal +OB) for Central Coalfields Ltd.

2.0   Objective

Objective of the land reclamation/restoration monitoring is to assess the area of backfilled, plantation, OB dumps, social forestry, active mining area, settlements and water bodies, distribution of wasteland, agricultural land and forest land in the leasehold area of the project. This is an important step taken up for assessing the progressive status of mined land reclamation and for taking up remedial measures, if any, required for environmental protection.

3.0   Methodology

There are number of steps involved between raw satellite data procurement and preparation of final map. National Remote Sensing Centre (NRSC) Hyderabad, being the nodal agency for satellite data supply in India, provides only raw digital satellite data, which needs further digital image processing for extracting the information and map preparation before uploading the same in the website. Methodology for land reclamation monitoring is given in given in fig 2. Following steps are involved in land reclamation /restoration monitoring:
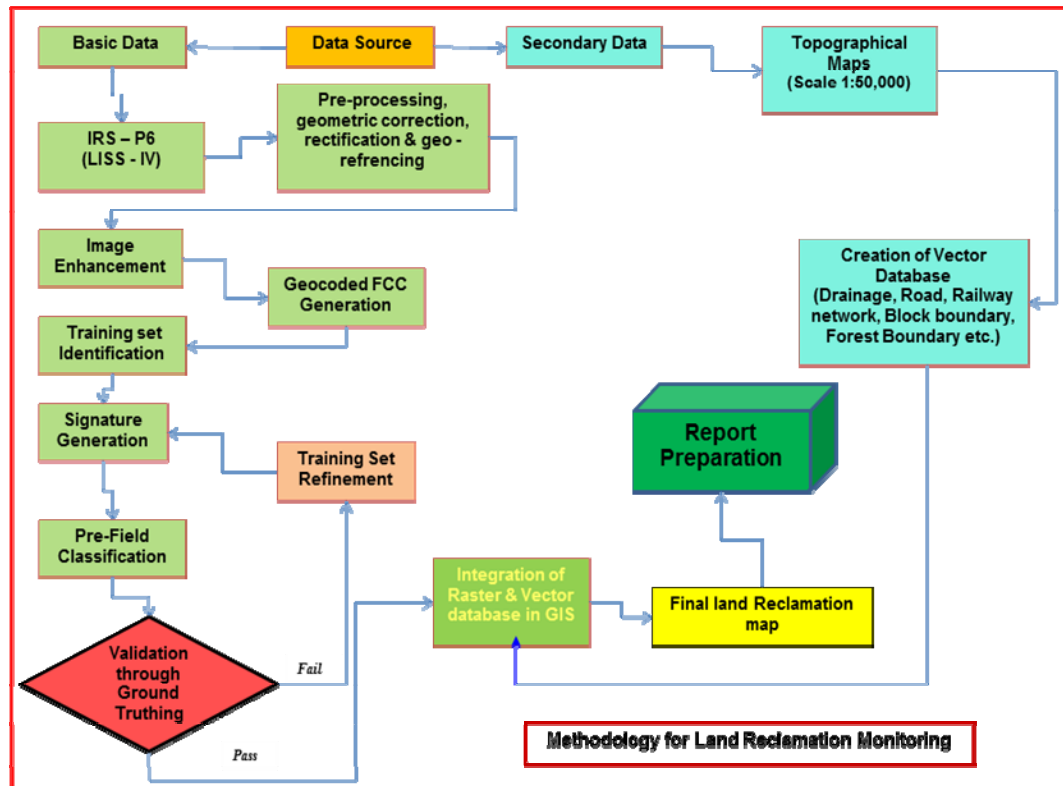
Figure: 2 Methodology for Land Reclamation Monitoring

3.1 Data Procurement: After browsing the data quality and date of pass on internet, supply order for data is placed to NRSC. Secondary data like leasehold boundary, topo sheets are procured for creation of vector database.

3.2 Satellite Data Processing: Satellite data are processed using ERDAS IMAGINE digital image processing s/w. Methodology involves the following major steps:

- **Rectification & Georeferencing:** Inaccuracies in digital imagery may occur due to 'systematic errors' attributed to earth curvature and rotation as well as 'non-systematic errors' attributed to satellite receiving station itself. Raw digital images contain geometric distortions, which make them unusable as maps. Therefore, georeferencing is required for correction of image data using ground control points (GCP) to make it compatible to SoI toposheet.

- Image enhancement:

  To improve the interpretability of the raw data, image enhancement is necessary. Local operations modify the value of each pixel based on brightness value of neighbouring pixels using ERDAS IMAGINE 13.0 s/w. and enhance the image quality for interpretation.

- Training set selection

  Training set requires to be selected, so that software can classify the image data accurately. The image data are analysed based on the interpretation keys. These keys are evolved from certain fundamental image-elements such as tone/colour, size, shape, texture, pattern, location, association and shadow. Based on the image-elements and other geo-technical elements like land form, drainage pattern and physiography; training sets were selected/identified for each land use/cover class. Field survey was carried out by taking selective traverses in order to collect the ground information (or reference data) so that training sets are selected accurately in the image. This was intended to serve as an aid for classification.

- Classification and Accuracy assessment

  Image classification is carried out using the maximum likelihood algorithm. The classification proceeds through the following steps: (a) calculation of statistics [i.e. signature generation] for the identified training areas, and (b) the decision boundary of maximum probability based on the mean vector, variance, covariance and correlation matrix of the pixels. After evaluating the statistical parameters of the training sets, reliability test of training sets is conducted by measuring the statistical separation between the classes that resulted from computing divergence matrix. The overall accuracy of the classification was finally assessed with reference to ground truth data.

- Area calculation

    The area of each land use class in the leasehold is determined using ERDAS IMAGINE v. 13.0 software and given in table 2.

- Overlay of Vector data base

    Vector data base created based on secondary data. Vector layer like drainage, railway line, leasehold boundary, forest boundary etc. are superimposed on the image as vector layer in the Arc GIS database.

- Pre-field map preparation

    Pre-field map is prepared for validation of the classification result

3.3 Ground Truthing:

Selective ground verification of the land use classes are carried out in the field and necessary corrections if required, are incorporated before map finalization.

3.4 Land reclamation database on GIS:

Land reclamation database is created on GIS platform to identify the temporal changes identified from satellite data of different cut-off dates.

4.0　Land Reclamation Status in Central Coalfields Ltd.

4.1　Following 5 OC projects producing more than 5 million m³. (Coal + OB together)of Central Coalfields Ltd. have been taken up during the year 2013 for land reclamation monitoring:

- Ashok
- Piparwar
- KD Hesalong(KDH)
- Rajrappa
- Parej East

4.2　Area statistics of different land use classes present in OC projects in the year 2013 is given in Table 2. Land use maps derived from the satellite data are given in Plate no. 1 to 5. Changes in land use status are shown in Fig. 3 – 7 and field photographs showing plantations in backfilled area in mining projects are shown in 1-6.

4.3　Study reveals that 80.94% of excavated mining area has already been reclaimed by CCL in the above 5 OC projects, out of which 60.12% area has been revegitated and 20.82% area is under backfilling.

4.4　After analyzing the satellite data of year 2013, it is seen that the plantation carried out on backfilled area, OB dumps as well as under social forestry in all the 5 mines of CCL has reached 15.68 Km^2 till the year 2013.

4.5　It may be seen from table.1 that the area of total reclamation has reached 80.94% of the total excvated area till the year 2013.

Table-2 STATUS OF LAND RECLAMATION IN CCL BASED ON SATELLITE DATA OF THE YEAR 2013

(Area in Sq. Km)

		ASHOK		PIPARWAR		KD HESALONG		RAJRAPPA		PAREJ EAST		TOTAL	
		Area	%	Area	%	Area	%	Area	%	Area	%	Area	%
FORESTS	Dense Forest	0.00	0.00	0.01	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02
FORESTS	Open Forest	0.67	9.93	0.15	1.34	0.15	3.33	1.50	7.57	1.39	22.42	3.86	7.96
	Total Forest	0.67	9.93	0.16	1.43	0.15	3.33	1.50	7.57	1.39	22.42	3.87	7.98
SCRUBS	Scrubs	1.37	20.30	0.70	6.25	0.55	12.22	5.54	27.95	1.42	22.90	9.58	19.76
PLANTATION	Social Forestry	0.34	5.04	2.40	21.44	0.12	2.67	1.95	9.84	0.12	1.94	4.93	10.17
PLANTATION	Plantation on OB Dump	0.00	0.00	0.80	7.15	0.11	2.44	3.89	19.63	0.48	7.74	5.28	10.89
PLANTATION	Plantation on Backfill	0.96	14.22	1.83	16.35	1.22	27.11	1.46	7.37	0.00	0.00	5.47	11.29
	Total Plantation (*Biological Reclamation*)	1.30	19.26	5.03	44.93	1.45	32.22	7.30	36.83	0.60	9.68	15.68	32.35
	Total Vegetation	3.34	49.48	5.89	52.61	2.15	47.78	14.34	72.35	3.41	55.00	29.13	60.10
ACTIVE MINING	Coal Quarry	0.57	8.44	1.42	12.71	0.20	4.53	0.60	3.03	0.32	5.16	3.11	6.42
ACTIVE MINING	Coal Face	0.03	0.37	0.02	0.13	0.00	0.00	0.01	0.05	0.01	0.16	0.07	0.14
ACTIVE MINING	Coal Dump	0.10	1.48	0.12	1.10	0.20	4.36	0.22	1.11	0.13	2.11	0.77	1.59
ACTIVE MINING	Advance Quarry Site	0.12	1.78	0.05	0.42	0.02	0.44	0.07	0.35	0.03	0.48	0.29	0.60
ACTIVE MINING	Quarry Filled With Water	0.10	1.48	0.21	1.85	0.13	2.80	0.27	1.36	0.02	0.31	0.73	1.51
	Total Area under *Active Mining*	0.92	13.55	1.82	16.21	0.55	12.13	1.17	5.90	0.51	8.22	4.97	10.25
RECLAIMED	Barren OB Dump	0.18	2.67	0.00	0.00	0.70	15.56	1.70	8.58	0.76	12.26	3.34	6.89
RECLAIMED	Area Under Backfilling	0.74	10.96	0.87	7.77	0.48	10.67	0.00	0.00	0.00	0.00	2.09	4.31
	Total Area under *Technical Reclamation*	0.92	13.63	0.87	7.77	1.18	26.23	1.70	8.58	0.76	12.26	5.43	11.20
	Total Area under *Mine Operation*	1.84	27.18	2.69	23.98	1.73	38.36	2.87	14.48	1.27	20.48	10.40	21.46
WASTELANDS	Waste Lands	0.19	2.81	0.16	1.43	0.31	6.78	0.28	1.43	0.12	1.94	1.06	2.19
WASTELANDS	Fly Ash Pond / Sand Body	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.32	0.02	0.04
	Total Wasteland	0.19	2.81	0.16	1.43	0.31	6.78	0.28	1.43	0.14	2.26	1.08	2.23
WATERBODIES	Reservoir, Nallah, Ponds	0.08	1.19	0.20	1.81	0.12	2.67	0.02	0.12	0.15	2.42	0.57	1.18
	Total Waterbodies	0.08	1.19	0.20	1.81	0.12	2.67	0.02	0.12	0.15	2.42	0.57	1.18
AGRICULTURE	Crop Lands	0.09	1.29	0.35	3.13	0.00	0.00	0.08	0.42	0.45	7.26	0.97	2.00
AGRICULTURE	Fallow Lands	1.14	16.89	1.10	9.83	0.01	0.29	1.24	6.26	0.16	2.58	3.65	7.53
	Total Agriculture	1.23	18.18	1.45	12.95	0.01	0.29	1.32	6.68	0.61	9.84	4.62	9.53
SETTLEMENTS	Urban Settlement	0.00	0.00	0.08	0.73	0.01	0.22	0.40	2.02	0.22	3.55	0.71	1.46
SETTLEMENTS	Rural Settlement	0.06	0.86	0.18	1.62	0.00	0.00	0.24	1.21	0.38	6.13	0.86	1.77
SETTLEMENTS	Industrial Settlement	0.02	0.30	0.54	4.86	0.18	3.91	0.34	1.72	0.02	0.32	1.10	2.27
	Total Settlement	0.08	1.16	0.80	7.20	0.19	4.13	0.98	4.94	0.62	10.00	2.67	5.51
	Grand Total	6.75	100.00	11.20	100.00	4.50	100.00	19.82	100.00	6.20	100.00	48.47	100.00
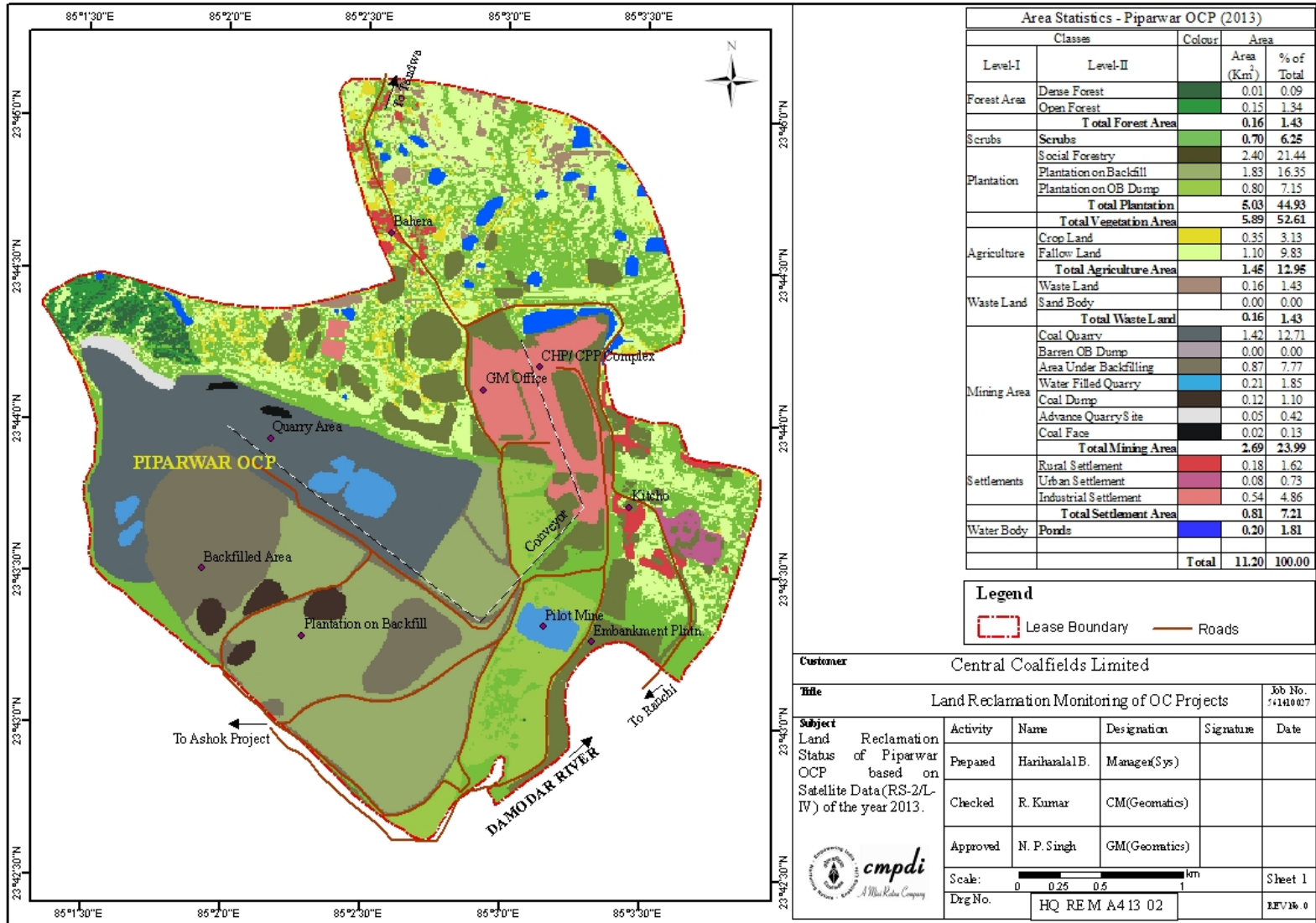
Area Statistics - Piparwar OCP (2013)

Classes (Level-I)	Classes (Level-II)	Colour	Area (Km²)	% of Total
Forest Area	Dense Forest		0.01	0.09
	Open Forest		0.15	1.34
	Total Forest Area		**0.16**	**1.43**
Scrubs	Scrubs		**0.70**	**6.25**
Plantation	Social Forestry		2.40	21.44
	Plantation on Backfill		1.83	16.35
	Plantation on OB Dump		0.80	7.15
	Total Plantation		**5.03**	**44.93**
	Total Vegetation Area		**5.89**	**52.61**
Agriculture	Crop Land		0.35	3.13
	Fallow Land		1.10	9.83
	Total Agriculture Area		**1.45**	**12.95**
Waste Land	Waste Land		0.16	1.43
	Sand Body		0.00	0.00
	Total Waste Land		**0.16**	**1.43**
Mining Area	Coal Quarry		1.42	12.71
	Barren OB Dump		0.00	0.00
	Area Under Backfilling		0.87	7.77
	Water Filled Quarry		0.21	1.85
	Coal Dump		0.12	1.10
	Advance Quarry Site		0.05	0.42
	Coal Face		0.02	0.13
	Total Mining Area		**2.69**	**23.99**
Settlements	Rural Settlement		0.18	1.62
	Urban Settlement		0.08	0.73
	Industrial Settlement		0.54	4.86
	Total Settlement Area		**0.81**	**7.21**
Water Body	Ponds		0.20	1.81
	Total		**11.20**	**100.00**

Legend

- Lease Boundary
- Roads

Customer	Central Coalfields Limited				
Title	Land Reclamation Monitoring of OC Projects				Job No. 561410027

Subject: Land Reclamation Status of Piparwar OCP based on Satellite Data (RS-2/L-IV) of the year 2013.

Activity	Name	Designation	Signature	Date
Prepared	Hariharalal B.	Manager(Sys)		
Checked	R. Kumar	CM(Geomatics)		
Approved	N. P. Singh	GM(Geomatics)		

Scale: 0 — 0.25 — 0.5 — 1 km

Sheet 1

Drg No. HQ REM A 41302

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cmpdi — A Mini Ratna Company

Plate – 2

Map labels: To Peddwa, Bahera, CHP/CPP Complex, GM Office, Kitcho, PIPARWAR OCP, Quarry Area, Conveyor, Backfilled Area, Plantation on Backfill, Pilot Mine, Embankment Plntn., To Ashok Project, DAMODAR RIVER, To Ranchi
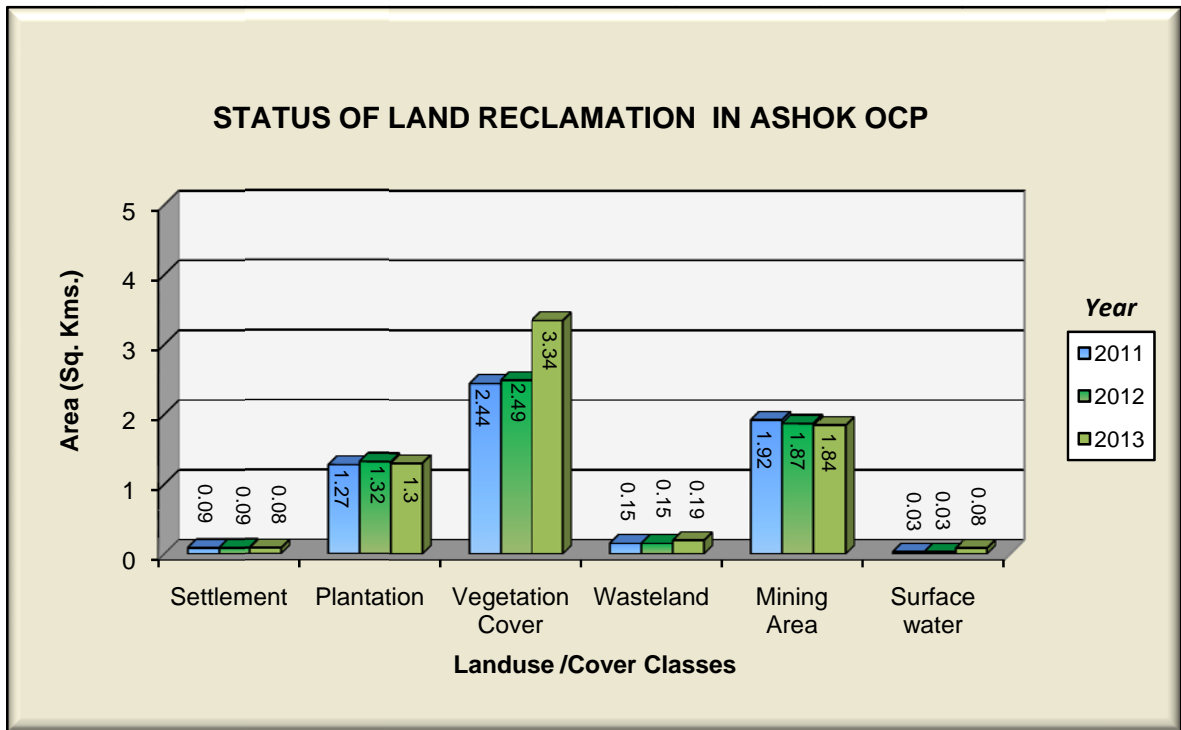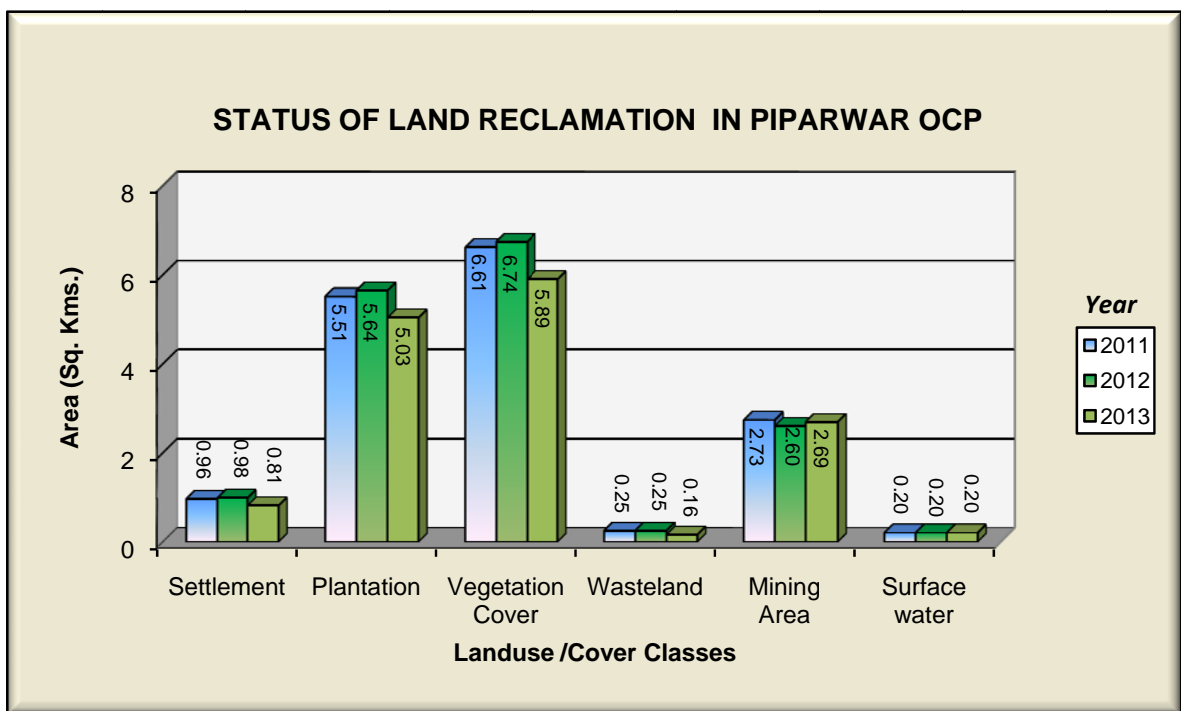
Figure 3

Figure 4

Plantation under Social Forestry- Piparwar OCP