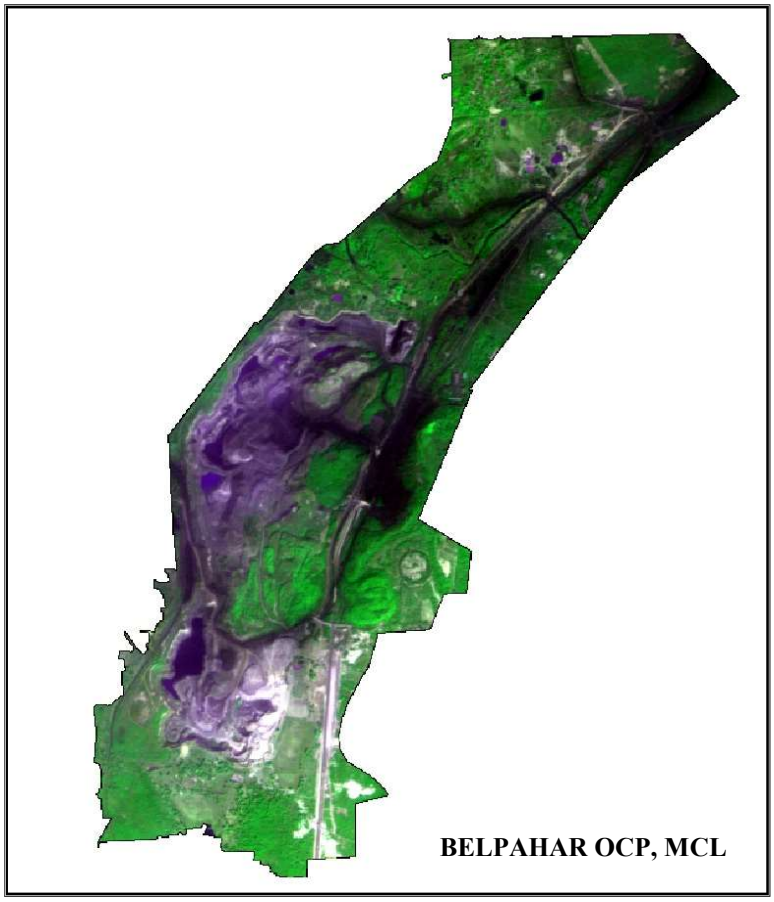
Land Restoration / Reclamation Monitoring of more than 5 million cu.m (Coal+OB) Capacity Opencast Coal Mines of Mahanadi Coalfields Limited based on Satellite Data of the Year 2019



Submitted to

Mahanadi Coalfields Limited

cmpdi

A Mini-Ratna Company

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February 2020

Remote Sensing Cell
Geomatics Division
CMPDI, Ranchi

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Executive Summary

1.0 Project

Land restoration / reclamation monitoring of 13 opencast coal mines of Mahanadi Coalfields Ltd. (MCL) producing 5 million cu.m. and more (Coal+OB) per annum based on satellite data on annual basis.

2.0 Objective

Objective of the land restoration / reclamation monitoring is to assess the area under backfilling, plantation, social forestry, active mining area, water bodies, 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

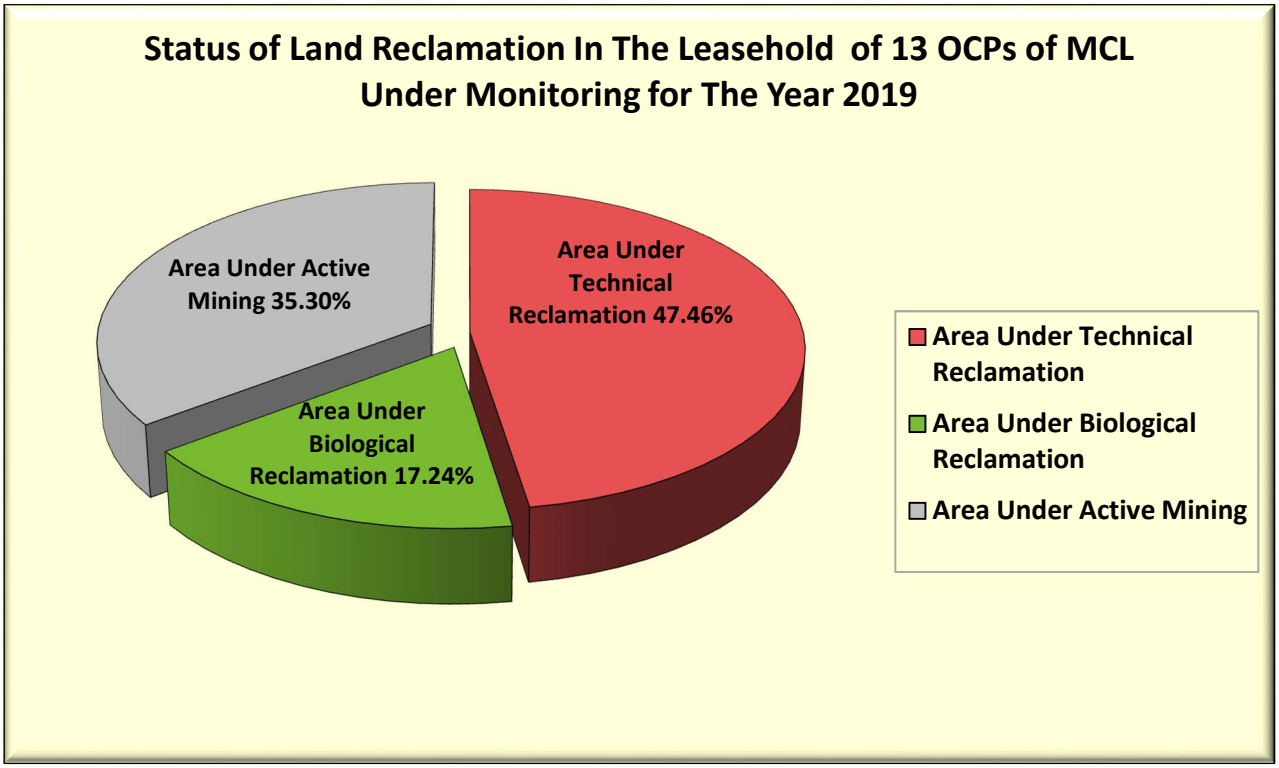
- Out of the total mine leasehold area of 145.02 Km^2 of the 13 opencast projects of MCL viz. Ananta, Balram, Lingaraj, Bharatpur, Bhubaneshwari, Jagannath, Hingula, Belpahar, Lakhanpur, Samleswari, Lajkura, Siarmal and Basundhara W. Extn. considered for monitoring during 2019-20; total excavated area is 47.91 Km^2, out of which 8.26 Km^2 area (17.24%) has been planted, 22.74 Km^2 area (47.46%) is under backfilling and 16.91 Km^2 area (35.30%) is under active mining. It is evident from the analysis that 64.70% areas of the OC projects is under reclamation (biological and technical) and balance 35.30% area is under active mining. Project wise details are given in Table-1 & Fig-1.

- On comparing the status of land reclamation for the year 2019 with respect to the year 2018 in different projects, it is evident from the analysis that area under land reclamation has increased from 29.46 Km^2 (Yr.2018) to 31.00 Km^2 (Yr.2019). Out of 13 projects of MCL, Balram OC ranks on top for land reclamation (78.89%) followed by Ananta OC (74.07%) and Samleswari OC (73.97%).

- Area of biological reclamation (plantation on backfill) has been increased from 8.17Km^2 (Yr.2018) to 8.26 Km^2 (Yr. 2019) and area of technical reclamation (area under backfilling) has increased from 21.29 Km^2 (Yr.2018) to 22.74 Km^2 (Yr.2019) in MCL. The increase of 1.54 Km^2 in total area of reclamation is the result of the efforts of the Mahanadi Coalfields Ltd. taken up towards environmental protection.

- In some of the projects it has been observed during field visit that natural vegetation has also started growing on the old and stabilized backfilled

area and dumps due to high soil fertility besides plantation carried out by MCL, resulting in higher vegetation cover than plantation done.



Pie Chart indicating distribution of reclamation activities in OC mines of MCL

Table – 1

Project wise Land Reclamation Status in Opencast Projects of MCL based on Satellite Data of the year 2019 (Area in Sq.km.)

Sl. No.	Project	Total Leasehold Area 2018	Total Leasehold Area 2019	Technical Reclamation		Plantation						Area Under Active Mining		Total Excavated Area		Total Area Under Plantation (%Green Cover Generated in Leasehold)		Total Area Under Reclamation	
						Biological Reclamation		Other Plantation											
				Area under Backfilling		Plantation on Excavated/Backfilled Area		Plantation on External Over Burden Dump		Social Forestry, Avenue Plantation Etc.									
1	2	3	4	5		6		7		8		9		10(=5+6+9)		11(=6+7+8)		12(=5+6)	
				2018	2019	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019
1	Ananta	14.20	14.20	2.33	2.35	1.01	1.02	0.11	0.11	0.23	0.23	0.82	1.18	4.16	4.55	1.35	1.36	3.34	3.37
				56.01%	51.65%	24.28%	22.42%					19.71%	25.93%			9.51%	9.58%	80.29%	74.07%
2	Balram	10.21	10.21	2.43	2.52	1.02	1.03	0.24	0.23	0.20	0.20	1.02	0.95	4.47	4.50	1.46	1.46	3.45	3.55
				54.36%	56.00%	22.82%	22.89%					22.82%	21.11%			14.30%	14.30%	77.18%	78.89%
3	Lingaraj	7.26	7.26	1.39	1.44	0.16	0.15	0.31	0.32	0.33	0.34	2.23	2.27	3.78	3.86	0.80	0.81	1.55	1.59
				36.77%	37.31%	4.23%	3.89%					58.99%	58.81%			11.02%	11.16%	41.01%	41.19%
4	Bharatpur	9.95	9.95	2.48	2.57	1.63	1.65	0.45	0.45	0.18	0.17	1.64	1.65	5.75	5.87	2.26	2.27	4.11	4.22
				43.13%	43.78%	28.35%	28.11%					28.52%	28.11%			22.71%	22.81%	71.48%	71.89%
5	Bhubaneswari	7.33	7.33	1.31	1.81	0.01	0.01	0.00	0.00	0.27	0.24	2.05	1.82	3.37	3.64	0.28	0.25	1.32	1.82
				38.87%	49.73%	0.30%	0.27%					60.83%	50.00%			3.82%	3.41%	39.17%	50.00%
6	Jagannath	5.54	5.54	0.75	0.76	1.79	1.79	0.00	0.00	0.17	0.17	1.01	1.01	3.55	3.56	1.96	1.96	2.54	2.55
				21.13%	21.35%	50.42%	50.28%					28.45%	28.37%			35.38%	35.38%	71.55%	71.63%
7	Hingula	5.44	15.75	1.18	1.33	0.07	0.06	0.21	0.21	0.21	0.28	1.53	1.75	2.78	3.14	0.49	0.55	1.25	1.39
				42.45%	42.36%	2.52%	1.91%					55.04%	55.73%			9.01%	3.49%	44.96%	44.27%
8	Belpahar	9.74	14.44	1.55	1.79	0.91	0.91	0.59	0.57	0.39	0.52	1.75	1.67	4.21	4.37	1.89	2.00	2.46	2.70
				36.82%	40.96%	21.62%	20.82%					41.57%	38.22%			19.40%	13.85%	58.43%	61.78%
9	Lakhanpur	22.40	22.40	3.90	4.12	0.72	0.80	0.59	0.59	0.46	0.45	2.41	2.51	7.03	7.43	1.77	1.84	4.62	4.92
				55.48%	55.45%	10.24%	10.77%					34.28%	33.78%			7.90%	8.21%	65.72%	66.22%
10	Samleswari	7.13	7.13	2.86	2.90	0.68	0.68	0.48	0.48	0.16	0.16	1.16	1.26	4.70	4.84	1.32	1.32	3.54	3.58
				60.85%	59.92%	14.47%	14.05%					24.68%	26.03%			18.51%	18.51%	75.32%	73.97%
11	Lajkura	4.68	4.68	1.11	1.15	0.17	0.16	0.22	0.22	0.07	0.06	0.69	0.84	1.97	2.15	0.46	0.44	1.28	1.31
				56.35%	53.49%	8.63%	7.44%					35.03%	39.07%			9.83%	9.40%	64.97%	60.93%
12	Siarmal	22.90	22.90	0.00	0.00	0.00	0.00	0.00	0.00	0.54	0.56	0.00	0.00	0.00	0.00	0.54	0.56	0.00	0.00
				0.00%	0.00%	0.00%	0.00%					0.00%	0.00%			2.36%	2.45%	–	–
13	Basundhara W Extn.	3.23	3.23	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.00	0.00	0.00	0.00	0.03	0.03	0.00	0.00
				0.00%	0.00%	0.00%	0.00%					0.00%	0.00%			0.93%	0.93%	–	–
Total(MCL)		130.01	145.02	21.29	22.74	8.17	8.26	3.20	3.18	3.24	3.41	16.31	16.91	45.77	47.91	14.61	14.85	29.46	31.00
				46.52%	47.46%	17.85%	17.24%					35.63%	35.30%			11.24%	10.24%	64.37%	64.70%

(% is calculated with respect to excavated area as applicable)

***Note**: In reference to the above Table-1, different parameters are classified as follows*:

1. *Area under **Biological Reclamation** includes Area under Plantation done on Backfilled Area only.*
2. *Area under **Technical Reclamation** includes Area under Barren Backfilling only.*
3. *Area under **Active Mining** includes Coal Quarry, Advance Quarry Site, Quarry Filled with Water, if any. Areas under coal dump have been excluded from Active Mining in this table.*
4. *Social Forestry and Plantation on External OB Dumps are not included in Biological Reclamation and are put under separate categories as shown in the Table above.*
5. *(%) calculated in the above Table is in respect to Total Excavated Area except for "Total Area under Plantation" where % is in terms of "Leasehold Area".*

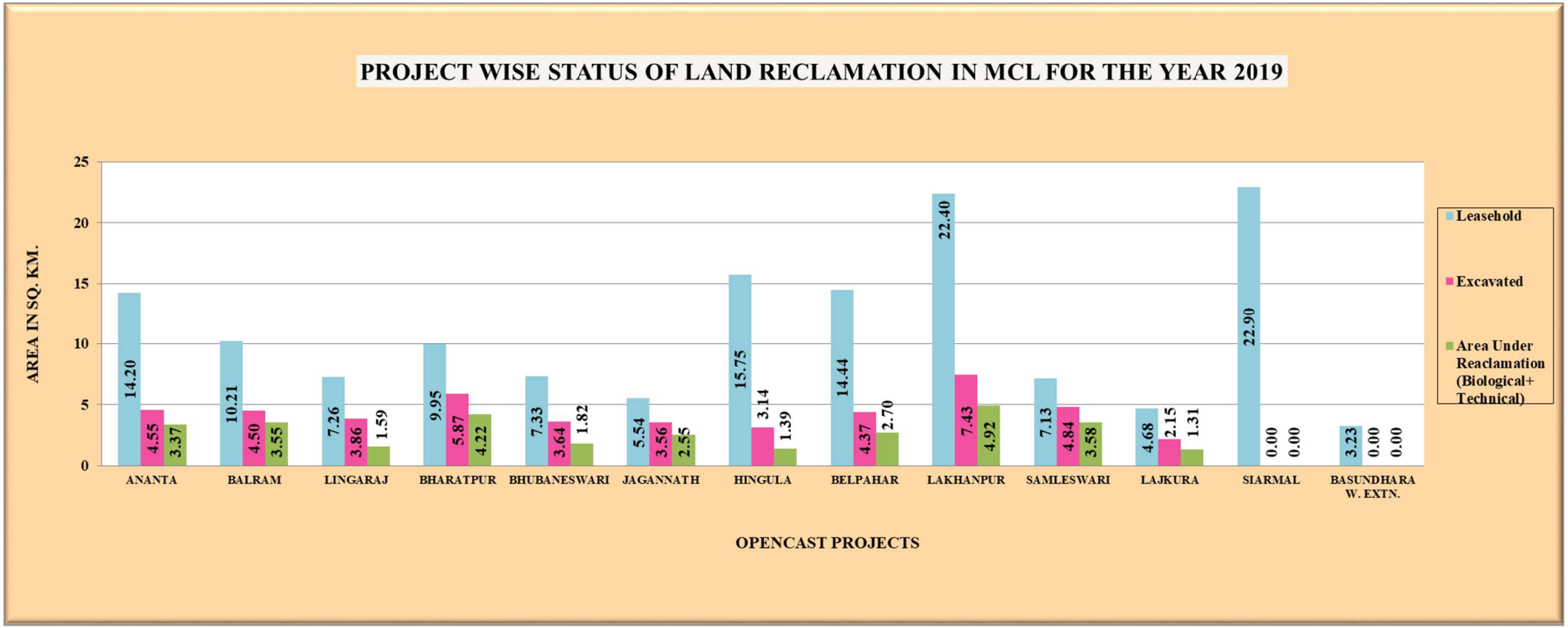


Fig.1: Land reclamation status in OC projects of MCL for the year 2019

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 most scarce 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/2009/2428 dated 29.12.2009 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 m3 per annum (coal + OB taken together per annum) based on remote sensing satellite data, regularly on annual basis for sustainable development of mining. Further, a revised work order was issued vide letter no. CIL/WBP/Env/2011/4706 dated 12.10.2012 from Coal India Limited for the period 2012-13 to 2016-17 which was subsequently followed by another work order vide letter no. CIL/WBP/Env/2017/DP/8477 dated 21.09.2017 from Coal India Limited for the period 2017-18 to 2021-22 for land reclamation monitoring of opencast projects and vegetation cover monitoring of 19 major coalfields. According to this work order, all mines in CIL with output capacity of 5 million cu. m (coal +OB) shall be monitored every year and all mines below this capacity shall be monitored at an interval of 3 years. All coalfields in CIL shall also be monitored at an interval of 3 years as per a defined plan. The result of land reclamation status of all such mines to be put on the website of CIL, (www.coalindia.in), CMPDI (www.cmpdi.co.in) and the concerned coal companies in public domain. Detail report to be submitted to Coal India and respective subsidiaries.

1.3 Land reclamation monitoring of all opencast 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 2019 carried out for all the OC projects producing more than 5 mcm (Coal+OB) for Mahanadi 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 Fig 2. Following steps are involved in land reclamation /restoration monitoring:

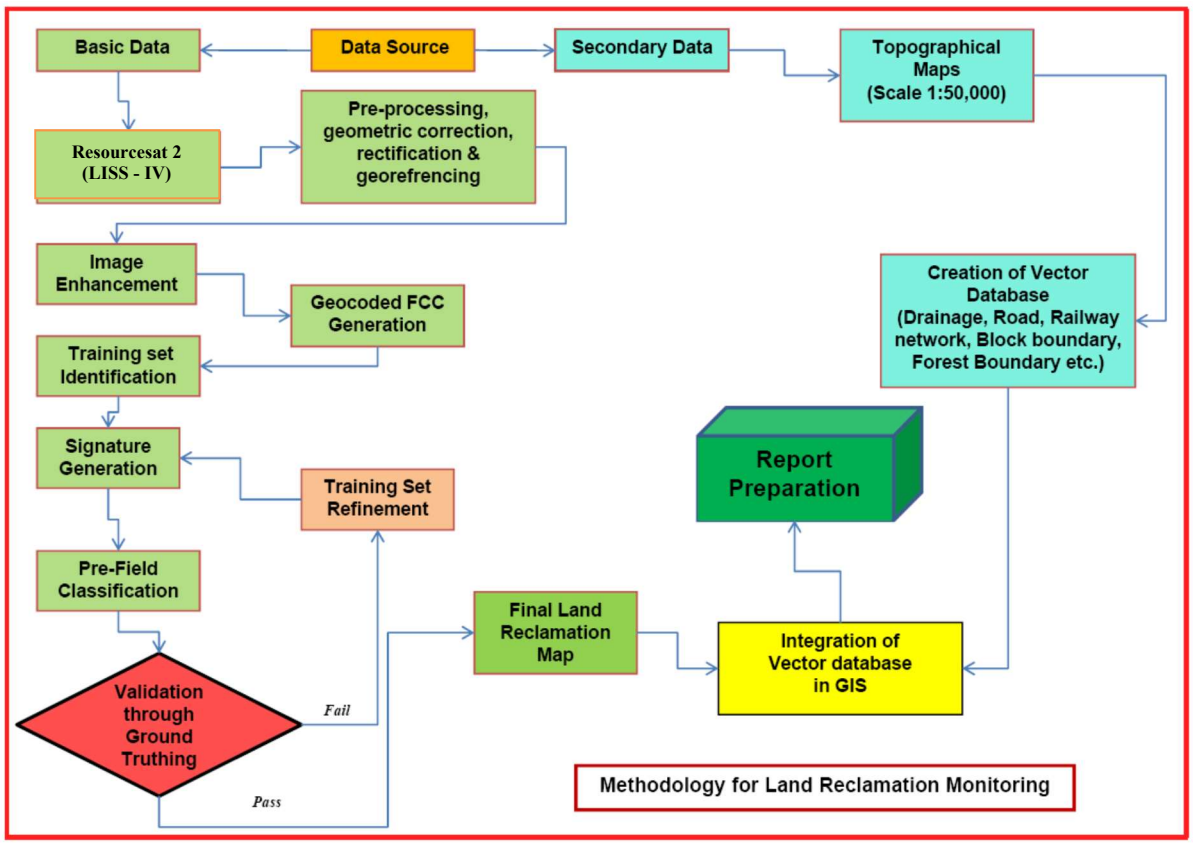


Figure: 2 - ***Methodology for Land Reclamation Monitoring***

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 2014 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 2014 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.2014 software.

- **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 10.2.2 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-of dates.

4.0 Land Reclamation Status in Mahanadi Coalfields Limited

4.1 Following thirteen opencast projects of MCL producing more than 5 million cubic meter and more (Coal + OB) were taken up for land reclamation monitoring based on satellite data of the year 2019.

- Ananta
- Balram
- Lingaraj
- Bharatpur
- Bhubaneswari
- Jagannath
- Hingula
- Belpahar
- Lakhanpur
- Samleswari
- Lajkura
- Siarmal
- Basundhara West Extension

4.2 Area statistics of different land use class present in the mine leasehold of the above projects for the year 2019 are shown in the Table -1. Land use maps derived from satellite data are shown in Plate 1 - 13. Land reclamation status of the above mentioned 13 projects, are also prepared for the year 2019. Year wise changes in the different land use classes based on satellite data are depicted in Bar Charts in Fig. 3 - 15.

4.3 Study reveals that out of total 47.91 Km^2 excavated area; 31.00 Km^2 area (64.70%) is under reclamation. Out of which 8.26 Km^2 (17.24%) area has been re-vegetated and 22.74 Km^2 (47.46%) area is under backfilling.

4.4 Analysis of satellite data indicates that area of plantation on backfill (Biological Reclamation) has increased from 8.17Km^2 (Yr.2018) to 8.26 Km^2 (Yr. 2019). This increase is due to the efforts of the Mahanadi Coalfields Ltd. taken up towards environmental protection.

4.5 Study also reveals that area under barren backfilling (Technical Reclamation) has increased from 21.29 Km^2 in 2018 to 22.74 Km^2 in 2019. All the 13 projects of MCL selected for monitoring are showing an increasing trend in technical reclamation.

4.6 It was also observed that overall total area under plantation (Green Cover) has increased from 14.61 Km^2 in 2018 to 14.85 Km^2 in 2019. Green Cover has reduced in some projects of MCL due to reduction in social forestry in the leasehold areas resulted from mine advancement.

4.7 Study indicates that in Balram and Belpahar OCPs, area of plantation on OB dumps has reduced marginally with respect to the year 2018 because of fresh OB dumping on vegetated OB Dump area due to constrain of spaces.

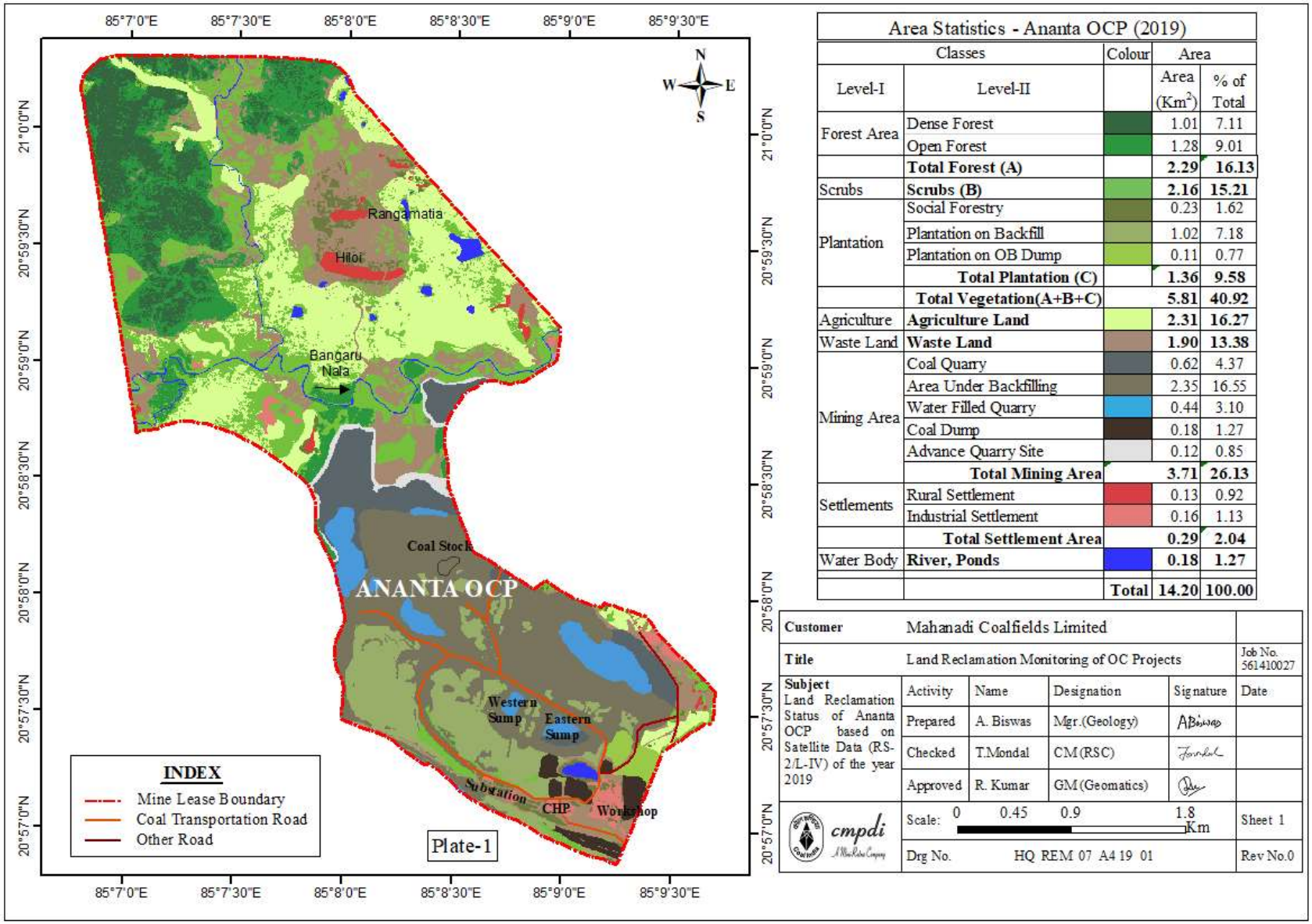
4.8 On comparing the status of land reclamation for the year 2019 with respect to the year 2018 in different projects, it is evident that area of land reclamation has increased from 29.46 Km^2 (Yr. 2018) to 31.00 Km^2 (Yr.2019).

4.9 Out of 13 projects of MCL, Balram OC ranks on top for land reclamation (78.89%) followed by Ananta OC (74.07%) and Samleswari OC (73.97%).

Table 2: STATUS OF LAND RESTORATION / RECLAMATION IN MAHANADI COALFIELDS LIMITED BASED ON SATELLITE DATA OF THE YEAR 2019

(Area in Sq. Kms.)

		ANANTA		BALRAM		LINGARAJ		BHARATPUR		BHUBANESHWARI		JAGANNATH		HINGULA		BELPAHAR		LAKHANPUR		SAMLESWARI		LAJKURA		SIARMAL		BASUNDHARA W EXTN		TOTAL	
		Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%
FORESTS	Dense Forest	1.01	7.11	0.00	0.00	0.00	0.00	0.01	0.10	0.00	0.00	0.00	0.00	1.20	7.62	0.00	0.00	1.78	7.95	0.05	0.70	0.92	19.64	0.00	0.00	0.00	0.00	4.97	3.43
	Open Forest	1.28	9.01	0.11	1.08	0.04	0.55	0.00	0.00	0.68	9.28	0.05	0.90	1.68	10.67	0.91	6.30	2.81	12.54	0.10	1.40	0.43	9.18	0.84	3.67	0.79	24.46	9.72	6.70
	Total Forest (A)	2.29	16.13	0.11	1.08	0.04	0.55	0.01	0.10	0.68	9.28	0.05	0.90	2.88	18.29	0.91	6.30	4.59	20.49	0.15	2.10	1.35	28.82	0.84	3.67	0.79	24.46	14.69	10.13
SCRUBS	**Scrubs (B)**	2.16	15.21	1.85	18.12	0.62	8.54	0.84	8.44	0.46	6.28	0.34	6.14	3.65	23.17	3.58	24.79	2.86	12.77	0.39	5.47	0.27	5.76	7.29	31.83	1.36	42.11	25.67	17.70
PLANTATION	Social Forestry	0.23	1.62	0.20	1.96	0.34	4.68	0.17	1.71	0.24	3.27	0.17	3.07	0.28	1.78	0.52	3.60	0.45	2.01	0.16	2.24	0.06	1.28	0.56	2.45	0.03	0.93	3.41	2.35
	Plantation on External OB Dump	0.11	0.77	0.23	2.25	0.32	4.41	0.45	4.52	0.00	0.00	0.00	0.00	0.21	1.33	0.57	3.95	0.59	2.63	0.48	6.73	0.22	4.70	0.00	0.00	0.00	0.00	3.18	2.19
	Plantation on Backfill/Excavated Area(Biological Reclamation)	1.02	7.18	1.03	10.09	0.15	2.07	1.65	16.58	0.01	0.14	1.79	32.31	0.06	0.38	0.91	6.30	0.80	3.57	0.68	9.54	0.16	3.42	0.00	0.00	0.00	0.00	8.26	5.70
	Total Plantation (Green Cover) (C)	**1.36**	**9.58**	**1.46**	**14.30**	**0.81**	**11.16**	**2.27**	**22.81**	**0.25**	**3.41**	**1.96**	**35.38**	**0.55**	**3.49**	**2.00**	**13.85**	**1.84**	**8.21**	**1.32**	**18.51**	**0.44**	**9.39**	**0.56**	**2.45**	**0.03**	**0.93**	**14.85**	**10.24**
	Total Vegetation (A+B+C)	**5.81**	**40.92**	**3.42**	**33.50**	**1.47**	**20.25**	**3.12**	**31.36**	**1.39**	**18.96**	**2.35**	**42.42**	**7.08**	**44.95**	**6.49**	**44.94**	**9.29**	**41.47**	**1.86**	**26.09**	**2.06**	**43.98**	**8.69**	**37.95**	**2.18**	**67.49**	**55.22**	**38.07**
ACTIVE MINING	Coal Dump	0.18	1.27	0.33	3.23	0.11	1.52	0.15	1.51	0.12	1.64	0.09	1.62	0.37	2.35	0.11	0.76	0.14	0.63	0.07	0.98	0.04	0.85	0.00	0.00	0.00	0.00	1.71	1.18
	Coal Quarry	0.62	4.37	0.50	4.90	1.96	27.00	0.93	9.35	1.63	22.24	0.31	5.60	0.72	4.57	1.33	9.21	2.04	9.11	1.00	14.03	0.75	16.01	0.00	0.00	0.00	0.00	11.79	8.13
	Advance Quarry Site	0.12	0.85	0.05	0.49	0.13	1.79	0.09	0.90	0.15	2.05	0.04	0.72	0.13	0.83	0.11	0.76	0.32	1.43	0.12	1.68	0.04	0.85	0.00	0.00	0.00	0.00	1.30	0.90
	Quarry Filled with Water	0.44	3.10	0.40	3.92	0.18	2.48	0.63	6.33	0.04	0.55	0.66	11.91	0.90	5.71	0.23	1.59	0.15	0.67	0.14	1.96	0.05	1.07	0.00	0.00	0.00	0.00	3.82	2.63
	Total Area under *Active Mining*	**1.18**	**8.31**	**0.95**	**9.30**	**2.27**	**31.27**	**1.65**	**16.58**	**1.82**	**24.83**	**1.01**	**18.23**	**1.75**	**11.11**	**1.67**	**11.57**	**2.51**	**11.21**	**1.26**	**17.67**	**0.84**	**17.93**	**0.00**	**0.00**	**0.00**	**0.00**	**16.91**	**11.66**
	Barren OB dump	0.00	0.00	0.13	1.27	0.50	6.89	0.05	0.50	0.78	10.64	0.00	0.00	0.02	0.13	0.13	0.90	0.02	0.09	0.07	0.98	0.03	0.64	0.00	0.00	0.00	0.00	1.73	1.19
	Area Under Backfilling(Technical Reclamation)	2.35	16.55	2.52	24.68	1.44	19.83	2.57	25.83	1.81	24.69	0.76	13.72	1.33	8.44	1.79	12.40	4.12	18.39	2.90	40.67	1.15	24.55	0.00	0.00	0.00	0.00	22.74	15.68
	Total Area under Mine Operation	**3.71**	**26.13**	**3.93**	**38.49**	**4.32**	**59.50**	**4.42**	**44.42**	**4.53**	**61.80**	**1.86**	**33.57**	**3.47**	**22.03**	**3.70**	**25.62**	**6.79**	**30.31**	**4.30**	**60.31**	**2.06**	**43.98**	**0.00**	**0.00**	**0.00**	**0.00**	**43.09**	**28.53**
WASTELANDS	Waste Lands	1.90	13.38	0.84	8.23	0.78	10.74	0.94	9.45	0.39	5.32	0.51	9.21	2.03	12.89	2.86	19.81	1.61	7.19	0.53	7.43	0.48	10.33	1.84	8.03	0.63	19.50	15.34	10.58
	Fly Ash Pond/Sand Body	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	1.99	0.06	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.12
	Total Wastelands	**1.90**	**13.38**	**0.84**	**8.23**	**0.78**	**10.74**	**0.94**	**9.45**	**0.39**	**5.32**	**0.62**	**11.19**	**2.09**	**13.27**	**2.86**	**19.81**	**1.61**	**7.19**	**0.53**	**7.43**	**0.48**	**10.33**	**1.84**	**8.03**	**0.63**	**19.50**	**15.51**	**10.70**
WATER	Reservoir, nallah, ponds etc.	0.18	1.27	0.19	1.86	0.05	0.69	0.06	0.60	0.03	0.41	0.05	0.90	0.33	2.10	0.26	1.80	0.26	1.16	0.06	0.84	0.01	0.21	0.21	0.92	0.02	0.62	1.71	1.18
	Total Waterbodies	**0.18**	**1.27**	**0.19**	**1.86**	**0.05**	**0.69**	**0.06**	**0.60**	**0.03**	**0.41**	**0.05**	**0.90**	**0.33**	**2.10**	**0.26**	**1.80**	**0.26**	**1.16**	**0.06**	**0.84**	**0.01**	**0.21**	**0.21**	**0.92**	**0.02**	**0.62**	**1.71**	**1.18**
AGRICULTURE	Crop Lands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.95	8.52	0.00	0.00	1.95	1.34
	Fallow Lands	2.31	16.27	1.30	12.73	0.37	5.10	1.11	11.16	0.88	12.01	0.50	9.03	2.53	16.06	0.71	4.92	4.19	18.71	0.19	2.66	0.00	0.00	9.50	41.48	0.38	11.76	23.97	16.53
	Total Agriculture	**2.31**	**16.27**	**1.30**	**12.73**	**0.37**	**5.10**	**1.11**	**11.16**	**0.88**	**12.01**	**0.50**	**9.03**	**2.53**	**16.06**	**0.71**	**4.92**	**4.19**	**18.71**	**0.19**	**2.66**	**0.00**	**0.00**	**11.45**	**50.00**	**0.38**	**11.76**	**25.92**	**17.87**
SETTLEMENTS	Urban Settlement	0.00	0.00	0.02	0.20	0.02	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.06	0.02	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.09	0.00	0.00	0.09	0.06
	Rural Settlement	0.13	0.92	0.11	1.08	0.06	0.83	0.04	0.40	0.09	1.23	0.05	0.90	0.22	1.40	0.17	1.18	0.14	0.63	0.02	0.28	0.00	0.00	0.69	3.01	0.02	0.62	1.74	1.20
	Industrial Settlement	0.16	1.13	0.40	3.92	0.19	2.62	0.26	2.61	0.02	0.27	0.11	1.99	0.02	0.13	0.23	1.59	0.12	0.54	0.17	2.38	0.07	1.49	0.00	0.00	0.00	0.00	1.75	1.21
	Total Settlements	**0.29**	**2.04**	**0.53**	**5.19**	**0.27**	**3.72**	**0.30**	**3.02**	**0.11**	**1.50**	**0.16**	**2.89**	**0.25**	**1.59**	**0.42**	**2.91**	**0.26**	**1.16**	**0.19**	**2.66**	**0.07**	**1.49**	**0.71**	**3.10**	**0.02**	**0.62**	**3.58**	**2.47**
	GRAND TOTAL	**14.20**	**100.00**	**10.21**	**100.00**	**7.26**	**100.00**	**9.95**	**100.00**	**7.33**	**100.00**	**5.54**	**100.00**	**15.75**	**100.00**	**14.44**	**100.00**	**22.40**	**100.00**	**7.13**	**100.00**	**4.68**	**100.00**	**22.90**	**100.00**	**3.23**	**100.00**	**145.02**	**100.00**



Area Statistics - Ananta OCP (2019)

Classes		Colour	Area	
Level-I	Level-II		Area (Km^2)	% of Total
Forest Area	Dense Forest		1.01	7.11
	Open Forest		1.28	9.01
	Total Forest (A)		**2.29**	**16.13**
Scrubs	**Scrubs (B)**		**2.16**	**15.21**
Plantation	Social Forestry		0.23	1.62
	Plantation on Backfill		1.02	7.18
	Plantation on OB Dump		0.11	0.77
	Total Plantation (C)		**1.36**	**9.58**
	Total Vegetation(A+B+C)		**5.81**	**40.92**
Agriculture	**Agriculture Land**		**2.31**	**16.27**
Waste Land	**Waste Land**		**1.90**	**13.38**
Mining Area	Coal Quarry		0.62	4.37
	Area Under Backfilling		2.35	16.55
	Water Filled Quarry		0.44	3.10
	Coal Dump		0.18	1.27
	Advance Quarry Site		0.12	0.85
	Total Mining Area		**3.71**	**26.13**
Settlements	Rural Settlement		0.13	0.92
	Industrial Settlement		0.16	1.13
	Total Settlement Area		**0.29**	**2.04**
Water Body	**River, Ponds**		**0.18**	**1.27**
		Total	**14.20**	**100.00**

Customer	Mahanadi Coalfields Limited				
Title	Land Reclamation Monitoring of OC Projects				Job No. 561410027
Subject Land Reclamation Status of Ananta OCP based on Satellite Data (RS-2/L-IV) of the year 2019	Activity	Name	Designation	Signature	Date
	Prepared	A. Biswas	Mgr.(Geology)	ABiswas	
	Checked	T.Mondal	CM(RSC)		
	Approved	R. Kumar	GM(Geomatics)		
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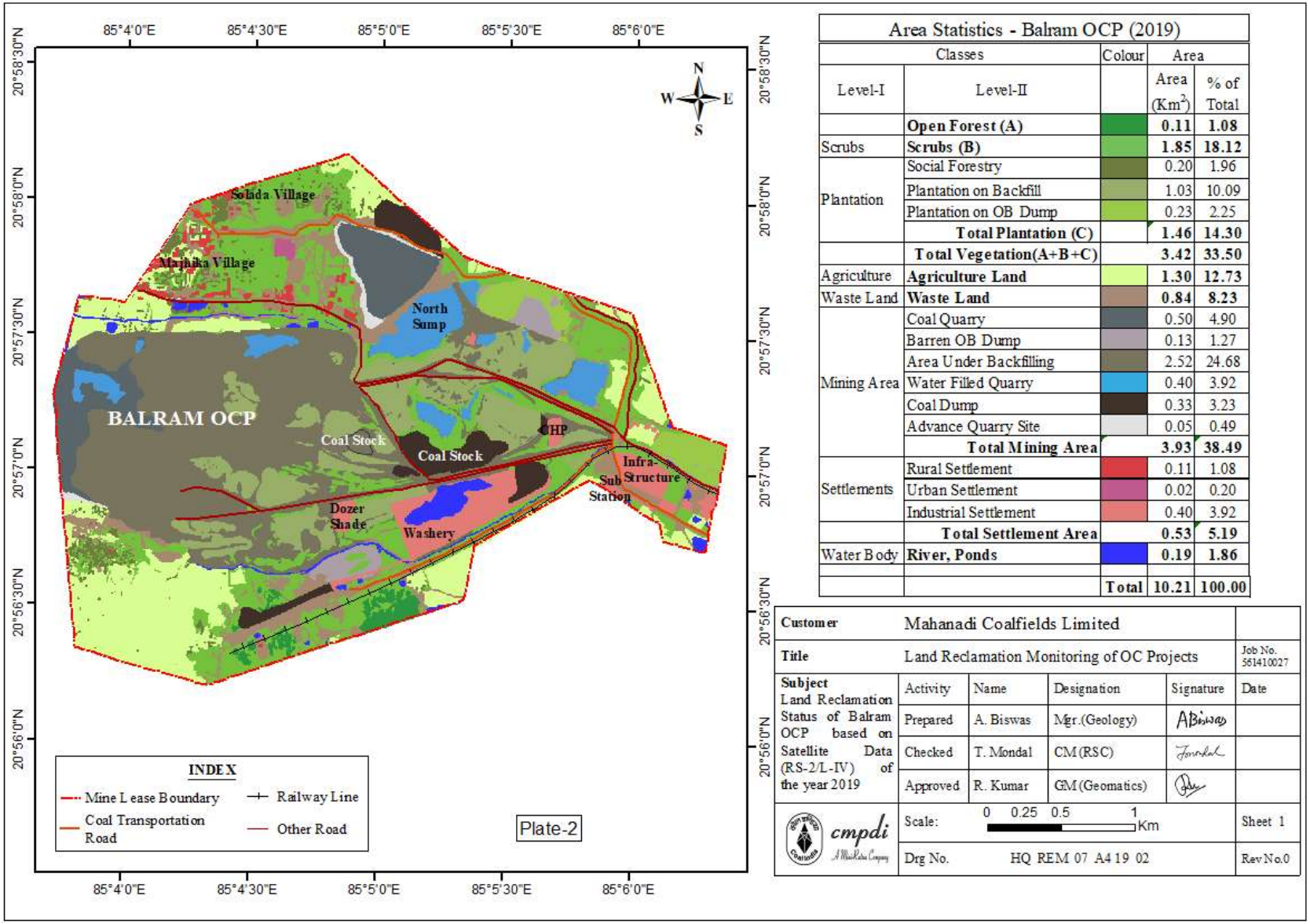
	Drg No. HQ REM 07 A4 19 01				Rev No.0



Area Statistics - Balram OCP (2019)

Classes		Colour	Area	
Level-I	Level-II		Area (Km^2)	% of Total
	Open Forest (A)		**0.11**	**1.08**
Scrubs	**Scrubs (B)**		**1.85**	**18.12**
Plantation	Social Forestry		0.20	1.96
	Plantation on Backfill		1.03	10.09
	Plantation on OB Dump		0.23	2.25
	Total Plantation (C)		**1.46**	**14.30**
	Total Vegetation(A+B+C)		**3.42**	**33.50**
Agriculture	**Agriculture Land**		**1.30**	**12.73**
Waste Land	**Waste Land**		**0.84**	**8.23**
Mining Area	Coal Quarry		0.50	4.90
	Barren OB Dump		0.13	1.27
	Area Under Backfilling		2.52	24.68
	Water Filled Quarry		0.40	3.92
	Coal Dump		0.33	3.23
	Advance Quarry Site		0.05	0.49
	Total Mining Area		**3.93**	**38.49**
Settlements	Rural Settlement		0.11	1.08
	Urban Settlement		0.02	0.20
	Industrial Settlement		0.40	3.92
	Total Settlement Area		**0.53**	**5.19**
Water Body	**River, Ponds**		**0.19**	**1.86**
		Total	**10.21**	**100.00**

Customer	Mahanadi Coalfields Limited				
Title	Land Reclamation Monitoring of OC Projects				Job No. 561410027
Subject Land Reclamation Status of Balram OCP based on Satellite Data (RS-2/L-IV) of the year 2019	Activity	Name	Designation	Signature	Date
	Prepared	A. Biswas	Mgr.(Geology)	ABiswas	
	Checked	T. Mondal	CM(RSC)		
	Approved	R. Kumar	GM(Geomatics)		
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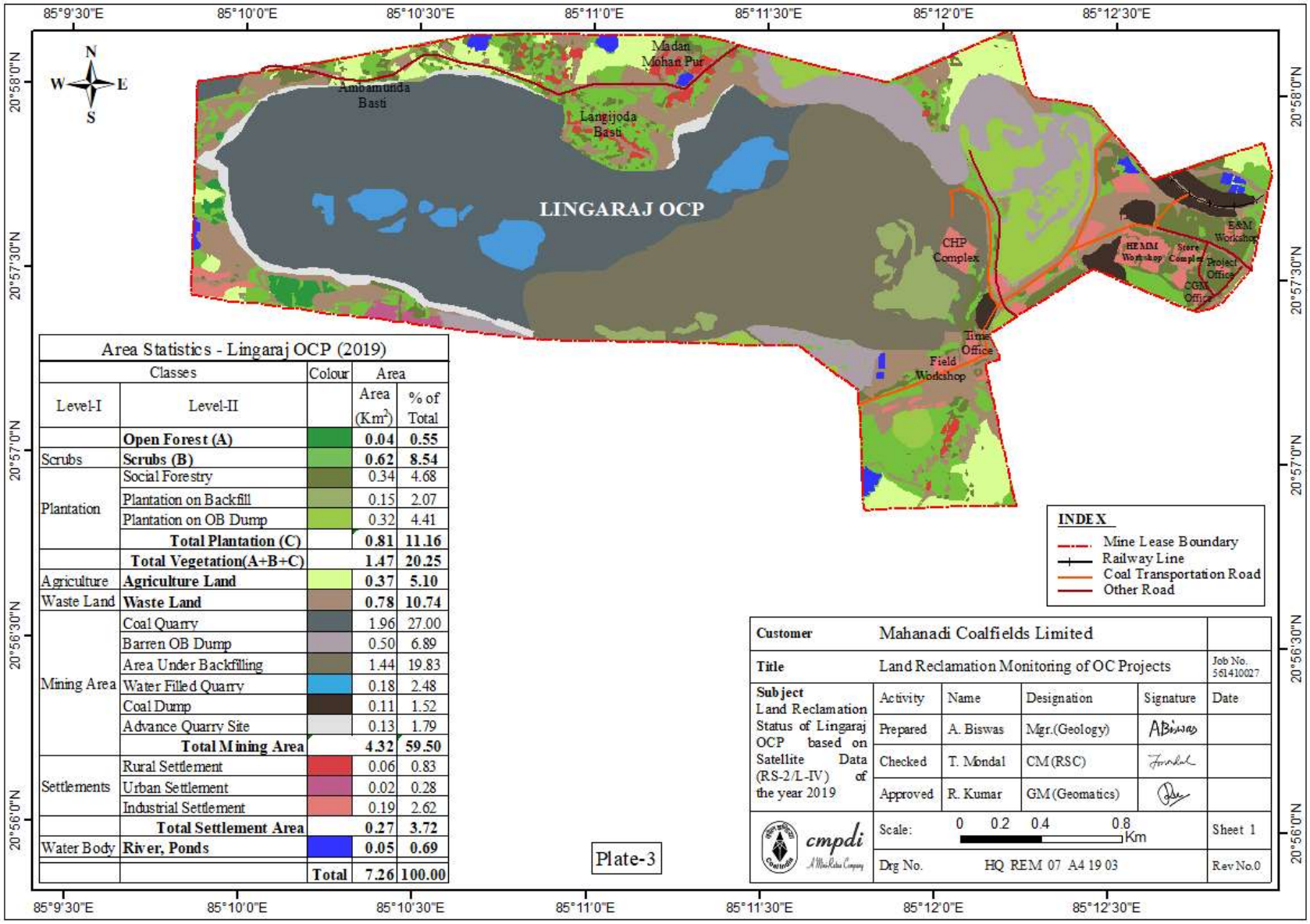
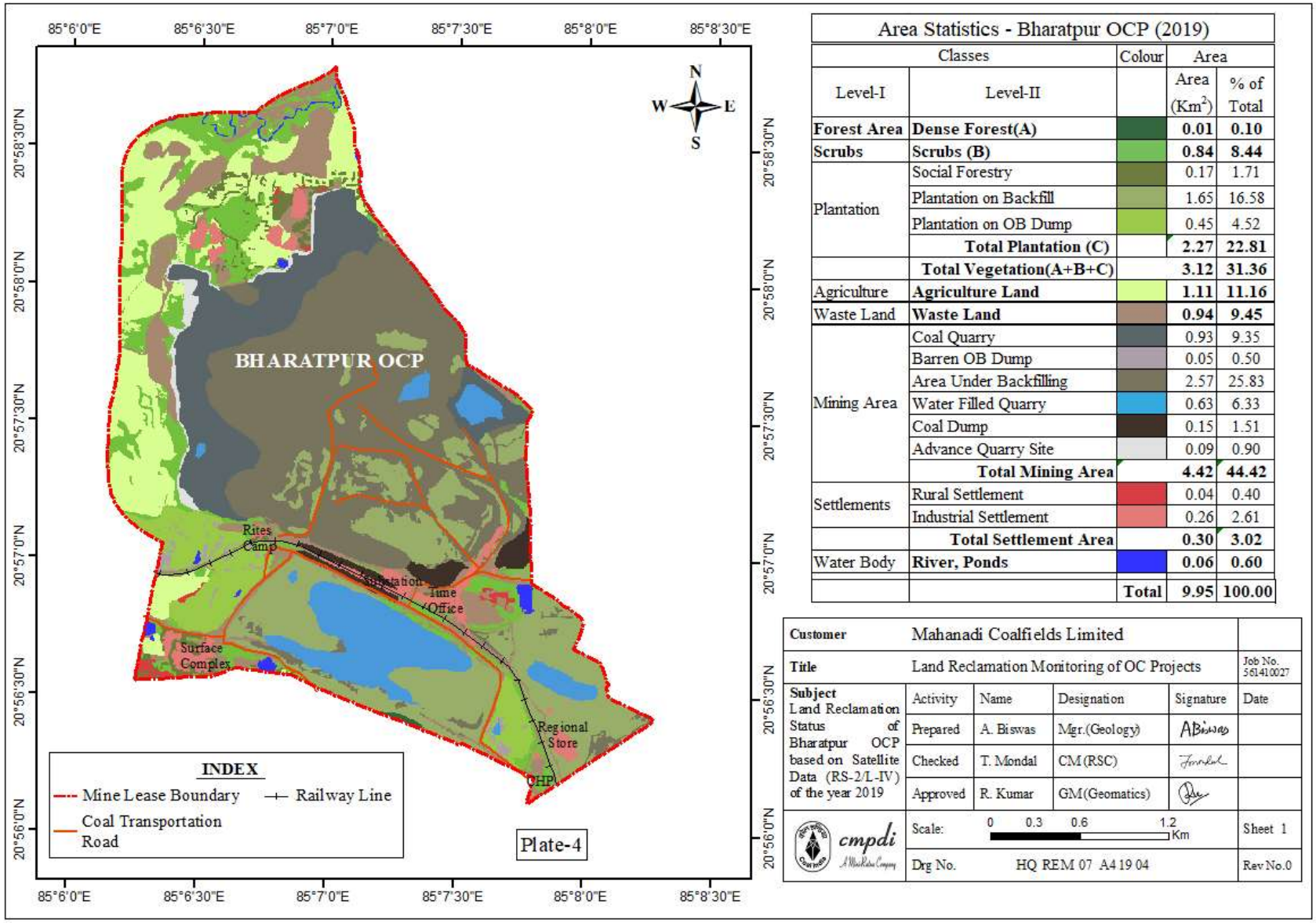


Area Statistics - Lingaraj OCP (2019)

Classes		Colour	Area	
Level-I	Level-II		Area (Km^2)	% of Total
	Open Forest (A)		**0.04**	**0.55**
Scrubs	**Scrubs (B)**		**0.62**	**8.54**
Plantation	Social Forestry		0.34	4.68
	Plantation on Backfill		0.15	2.07
	Plantation on OB Dump		0.32	4.41
	Total Plantation (C)		**0.81**	**11.16**
	Total Vegetation(A+B+C)		**1.47**	**20.25**
Agriculture	**Agriculture Land**		**0.37**	**5.10**
Waste Land	**Waste Land**		**0.78**	**10.74**
Mining Area	Coal Quarry		1.96	27.00
	Barren OB Dump		0.50	6.89
	Area Under Backfilling		1.44	19.83
	Water Filled Quarry		0.18	2.48
	Coal Dump		0.11	1.52
	Advance Quarry Site		0.13	1.79
	Total Mining Area		**4.32**	**59.50**
Settlements	Rural Settlement		0.06	0.83
	Urban Settlement		0.02	0.28
	Industrial Settlement		0.19	2.62
	Total Settlement Area		**0.27**	**3.72**
Water Body	**River, Ponds**		**0.05**	**0.69**
		Total	**7.26**	**100.00**

Plate-3

Customer	Mahanadi Coalfields Limited				
Title	Land Reclamation Monitoring of OC Projects				Job No. 561410027
Subject Land Reclamation Status of Lingaraj OCP based on Satellite Data (RS-2/L-IV) of the year 2019	Activity	Name	Designation	Signature	Date
	Prepared	A. Biswas	Mgr.(Geology)	ABiswas	
	Checked	T. Mondal	CM(RSC)		
	Approved	R. Kumar	GM(Geomatics)		
cmpdi	Scale: 0 0.2 0.4 0.8 Km				Sheet 1
	Drg No. HQ REM 07 A4 19 03				Rev No.0



Area Statistics - Bharatpur OCP (2019)

Classes		Colour	Area	
Level-I	Level-II		Area (Km^2)	% of Total
Forest Area	**Dense Forest(A)**		**0.01**	**0.10**
Scrubs	**Scrubs (B)**		**0.84**	**8.44**
Plantation	Social Forestry		0.17	1.71
	Plantation on Backfill		1.65	16.58
	Plantation on OB Dump		0.45	4.52
	Total Plantation (C)		**2.27**	**22.81**
	Total Vegetation(A+B+C)		**3.12**	**31.36**
Agriculture	**Agriculture Land**		**1.11**	**11.16**
Waste Land	**Waste Land**		**0.94**	**9.45**
Mining Area	Coal Quarry		0.93	9.35
	Barren OB Dump		0.05	0.50
	Area Under Backfilling		2.57	25.83
	Water Filled Quarry		0.63	6.33
	Coal Dump		0.15	1.51
	Advance Quarry Site		0.09	0.90
	Total Mining Area		**4.42**	**44.42**
Settlements	Rural Settlement		0.04	0.40
	Industrial Settlement		0.26	2.61
	Total Settlement Area		**0.30**	**3.02**
Water Body	**River, Ponds**		**0.06**	**0.60**
		Total	**9.95**	**100.00**

Customer	Mahanadi Coalfields Limited				
Title	Land Reclamation Monitoring of OC Projects				Job No. 561410027
Subject Land Reclamation Status of Bharatpur OCP based on Satellite Data (RS-2/L-IV) of the year 2019	Activity	Name	Designation	Signature	Date
	Prepared	A. Biswas	Mgr.(Geology)	ABiswas	
	Checked	T. Mondal	CM (RSC)		
	Approved	R. Kumar	GM(Geomatics)		
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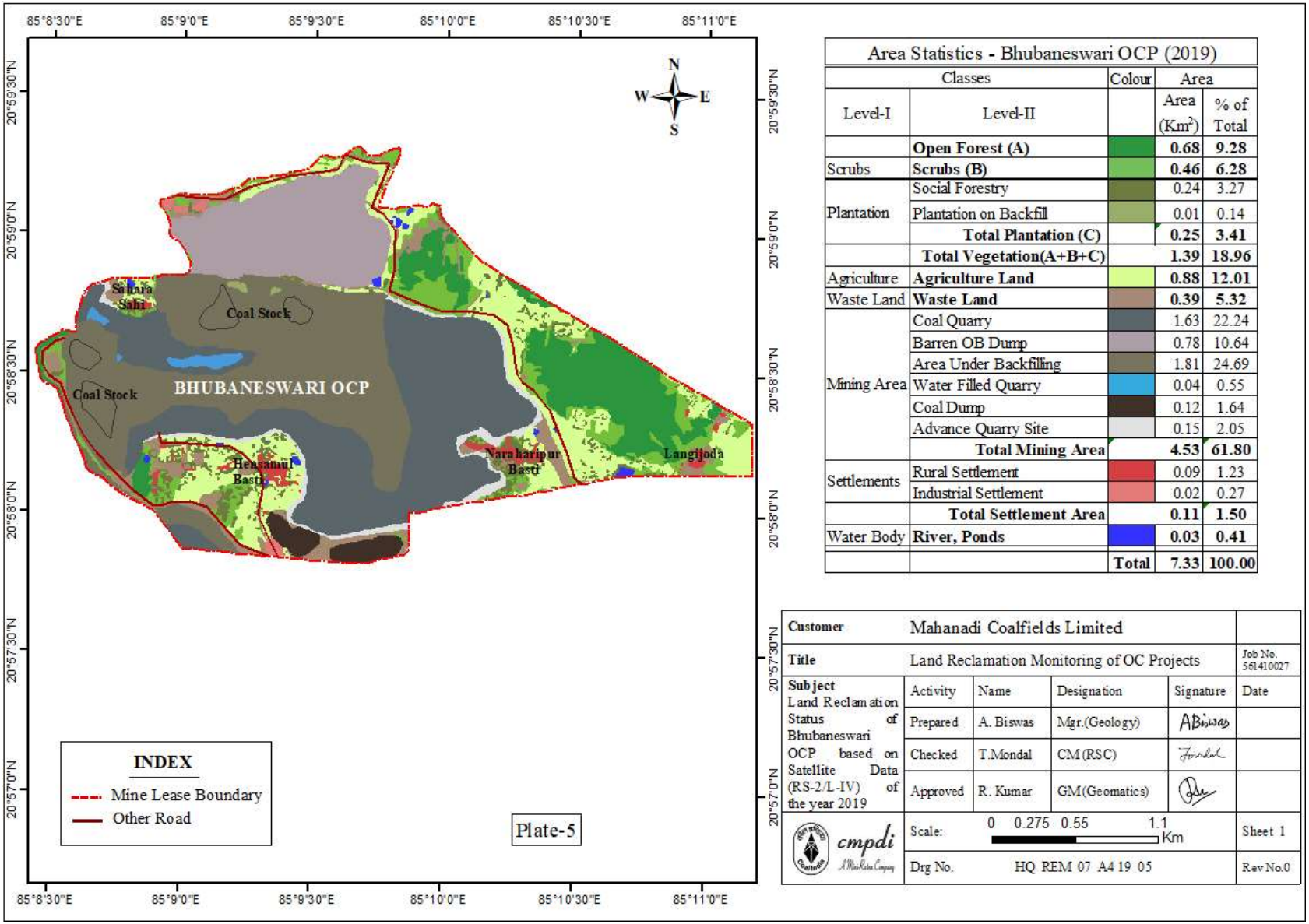
	Drg No. HQ REM 07 A4 19 04				Rev No.0



Area Statistics - Bhubaneswari OCP (2019)

Classes		Colour	Area	
Level-I	Level-II		Area (Km^2)	% of Total
	Open Forest (A)		**0.68**	**9.28**
Scrubs	**Scrubs (B)**		**0.46**	**6.28**
Plantation	Social Forestry		0.24	3.27
	Plantation on Backfill		0.01	0.14
	Total Plantation (C)		**0.25**	**3.41**
	Total Vegetation(A+B+C)		**1.39**	**18.96**
Agriculture	**Agriculture Land**		**0.88**	**12.01**
Waste Land	**Waste Land**		**0.39**	**5.32**
Mining Area	Coal Quarry		1.63	22.24
	Barren OB Dump		0.78	10.64
	Area Under Backfilling		1.81	24.69
	Water Filled Quarry		0.04	0.55
	Coal Dump		0.12	1.64
	Advance Quarry Site		0.15	2.05
	Total Mining Area		**4.53**	**61.80**
Settlements	Rural Settlement		0.09	1.23
	Industrial Settlement		0.02	0.27
	Total Settlement Area		**0.11**	**1.50**
Water Body	**River, Ponds**		**0.03**	**0.41**
		Total	**7.33**	**100.00**

Customer	Mahanadi Coalfields Limited				
Title	Land Reclamation Monitoring of OC Projects				Job No. 561410027
Subject Land Reclamation Status of Bhubaneswari OCP based on Satellite Data (RS-2/L-IV) of the year 2019	Activity	Name	Designation	Signature	Date
	Prepared	A. Biswas	Mgr.(Geology)	ABiswas	
	Checked	T.Mondal	CM(RSC)		
	Approved	R. Kumar	GM(Geomatics)		
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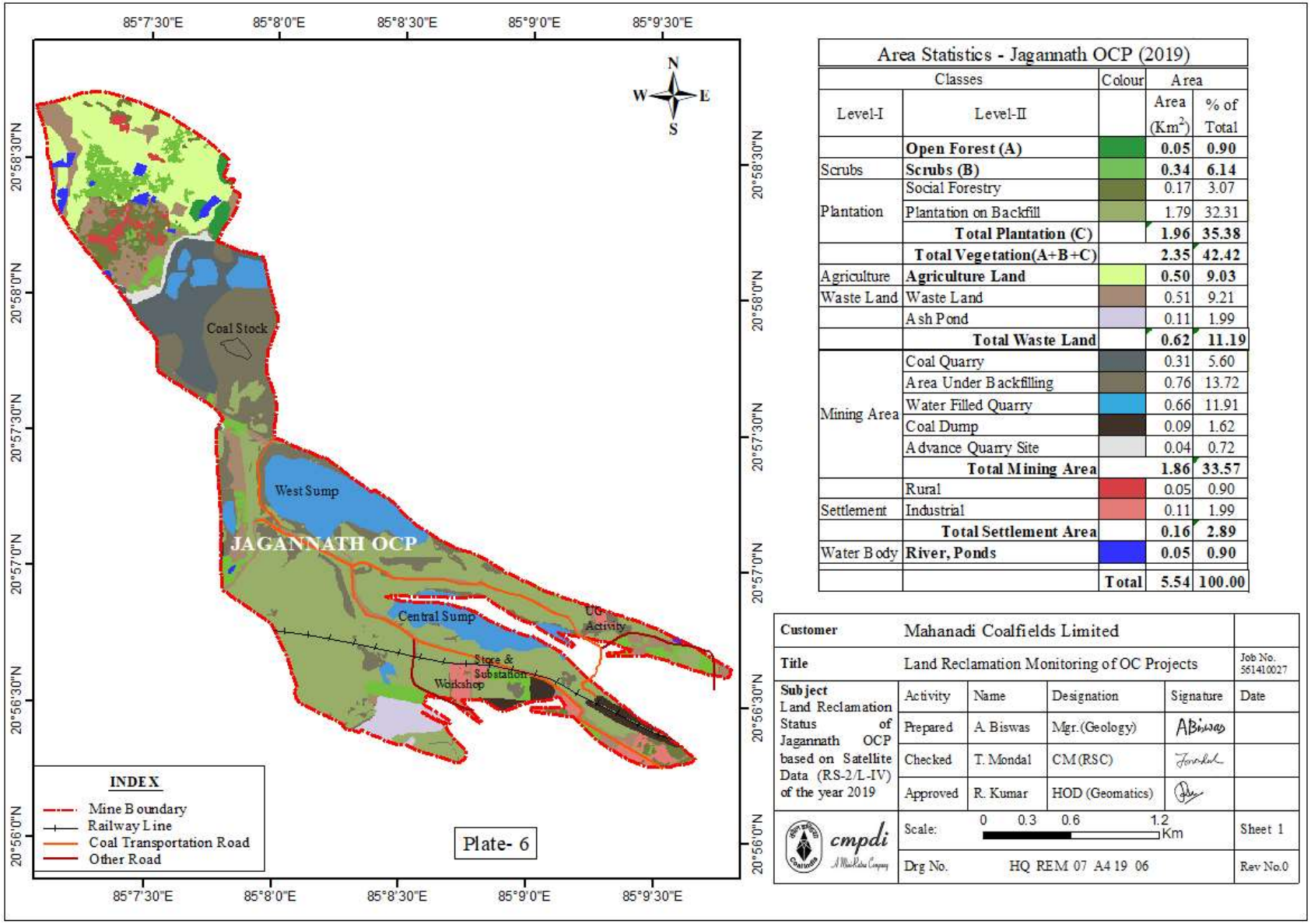

Area Statistics - Jagannath OCP (2019)

Classes		Colour	Area	
Level-I	Level-II		Area (Km^2)	% of Total
	Open Forest (A)		**0.05**	**0.90**
Scrubs	**Scrubs (B)**		**0.34**	**6.14**
Plantation	Social Forestry		0.17	3.07
	Plantation on Backfill		1.79	32.31
	Total Plantation (C)		**1.96**	**35.38**
	Total Vegetation(A+B+C)		**2.35**	**42.42**
Agriculture	**Agriculture Land**		**0.50**	**9.03**
Waste Land	Waste Land		0.51	9.21
	Ash Pond		0.11	1.99
	Total Waste Land		**0.62**	**11.19**
Mining Area	Coal Quarry		0.31	5.60
	Area Under Backfilling		0.76	13.72
	Water Filled Quarry		0.66	11.91
	Coal Dump		0.09	1.62
	Advance Quarry Site		0.04	0.72
	Total Mining Area		**1.86**	**33.57**
Settlement	Rural		0.05	0.90
	Industrial		0.11	1.99
	Total Settlement Area		**0.16**	**2.89**
Water Body	**River, Ponds**		**0.05**	**0.90**
		Total	**5.54**	**100.00**

Customer	Mahanadi Coalfields Limited				
Title	Land Reclamation Monitoring of OC Projects				Job No. 561410027
Subject Land Reclamation Status of Jagannath OCP based on Satellite Data (RS-2/L-IV) of the year 2019	Activity	Name	Designation	Signature	Date
	Prepared	A. Biswas	Mgr. (Geology)	ABiswas	
	Checked	T. Mondal	CM (RSC)		
	Approved	R. Kumar	HOD (Geomatics)		
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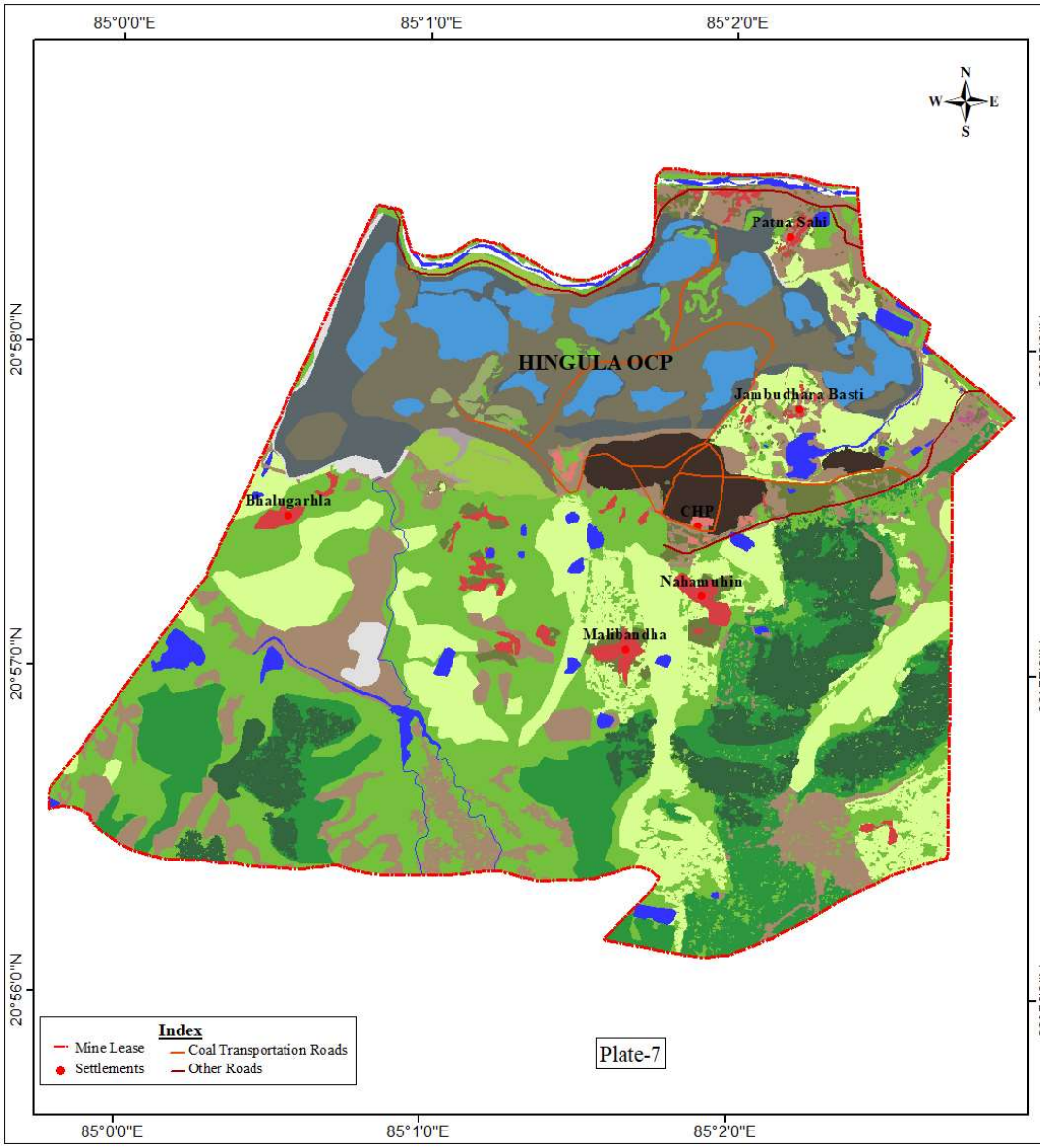

Area Statistics - Hingula OCP (2019)				
Classes		Colour	Area	
Level-I	Level-II		Area (Km^2)	% of Total
Forest	Dense Forest		1.20	7.62
	Open Forest		1.68	10.67
	Total Forest(A)		**2.88**	**18.29**
Scrubs	**Scrubs (B)**		**3.65**	**23.17**
Plantation	Social Forestry		0.28	1.78
	Plantation on Backfill		0.06	0.38
	Plantation on OB Dump		0.21	1.33
	Total Plantation (C)		**0.55**	**3.49**
	Total Vegetation(A+B+C)		**7.08**	**44.95**
Agriculture	**Agriculture Land**		2.53	16.06
Waste Land	Waste Land		2.03	12.89
	Sand Body		0.06	0.38
	Total Waste Land		**2.09**	**13.27**
Mining Area	Coal Quarry		0.72	4.57
	Barren OB Dump		0.02	0.13
	Area Under Backfilling		1.33	8.44
	Water Filled Quarry		0.90	5.71
	Coal Dump		0.37	2.35
	Advance Quarry Site		0.13	0.83
	Total Mining Area		**3.47**	**22.03**
Settlements	Rural Settlement		0.22	1.40
	Urban Settlement		0.01	0.06
	Industrial Settlement		0.02	0.13
	Total Settlement Area		**0.25**	**1.59**
Water Body	**River, Ponds**		**0.33**	**2.10**
		Total	**15.75**	**100.00**

Customer	Mahanadi Coalfields Limited				
Title	Land Reclamation Monitoring of OC Projects				Job No. 561410027
Subject Land Reclamation Status of Hingula OCP based on Satellite Data (RS-2/L-IV) of the year 2019	Activity	Name	Designation	Signature	Date
	Prepared	A. Biswas	Mgr.(Geology)	ABiswas	
	Checked	T. Mondal	CM (RSC)		
	Approved	R. Kumar	GM (Geomatics)		
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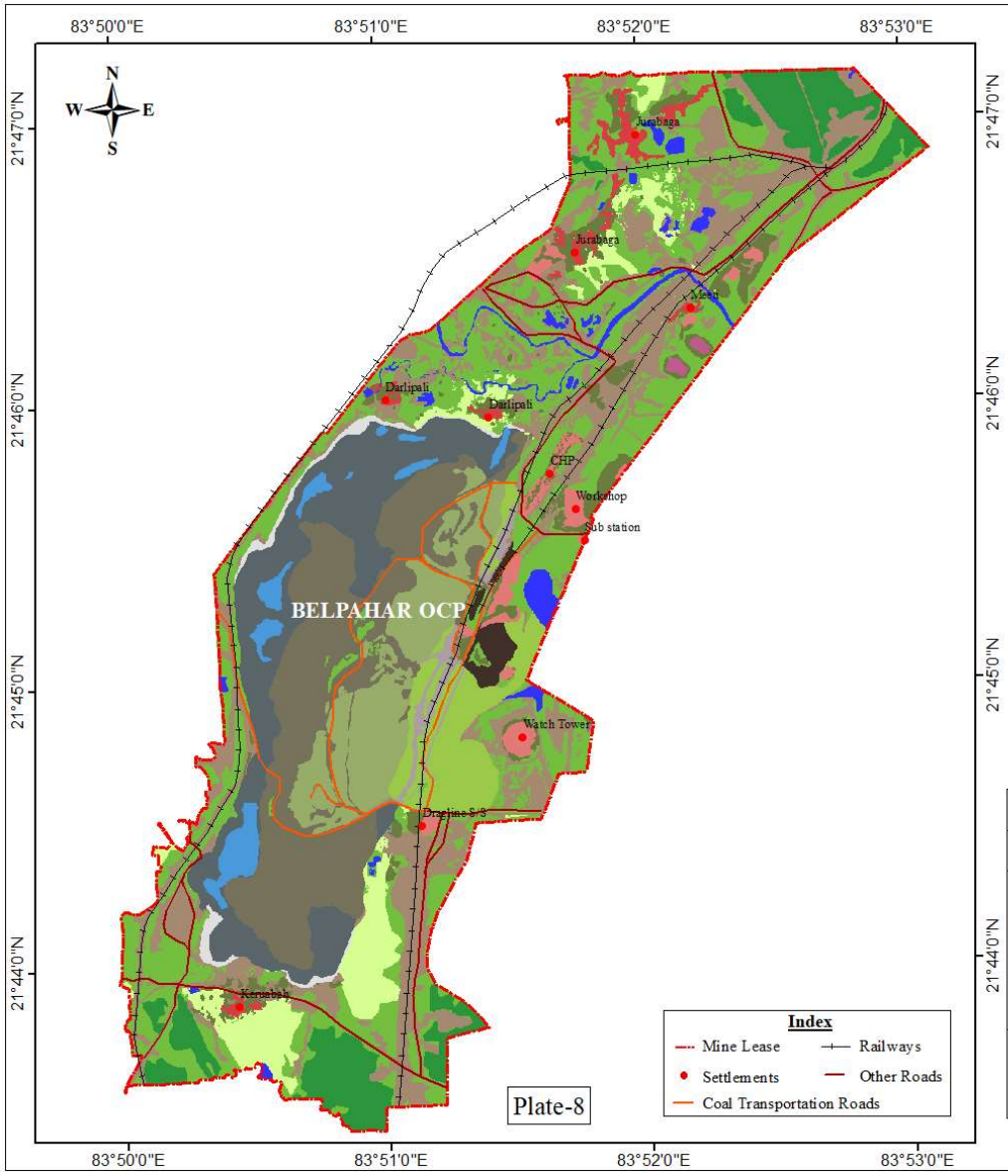

Area Statistics - Belpahar OCP (2019)

Classes		Colour	Area	
Level-I	Level-II		Area (Km^2)	% of Total
Forest	**Open Forest(A)**		**0.91**	**6.30**
Scrubs	**Scrubs (B)**		**3.58**	**24.79**
Plantation	Social Forestry		0.52	3.60
	Plantation on Backfill		0.91	6.30
	Plantation on OB Dump		0.57	3.95
	Total Plantation (C)		**2.00**	**13.85**
	Total Vegetation(A+B+C)		**6.49**	**44.94**
Agriculture	**Agriculture Land**		**0.71**	**4.92**
Waste Land	**Waste Land**		**2.86**	**19.81**
Mining Area	Coal Quarry		1.33	9.21
	Barren OB Dump		0.13	0.90
	Area Under Backfilling		1.79	12.40
	Water Filled Quarry		0.23	1.59
	Coal Dump		0.11	0.76
	Advance Quarry Site		0.11	0.76
	Total Mining Area		**3.70**	**25.62**
Settlements	Rural Settlement		0.17	1.18
	Urban Settlement		0.02	0.14
	Industrial Settlement		0.23	1.59
	Total Settlement Area		**0.42**	**2.91**
Water Body	**River, Ponds**		**0.26**	**1.80**
		Total	**14.44**	**100.00**

Customer	Mahanadi Coalfields Limited				
Title	Land Reclamation Monitoring of OC Projects				Job No. 561410027
Subject Land Reclamation Status of Belpahar OCP based on Satellite Data (RS-2/L-IV) of the year 2019	Activity	Name	Designation	Signature	Date
	Prepared	A. Biswas	Mgr.(Geology)	ABiswas	
	Checked	T. Mondal	CM (RSC)		
	Approved	R. Kumar	GM(Geomatics)		
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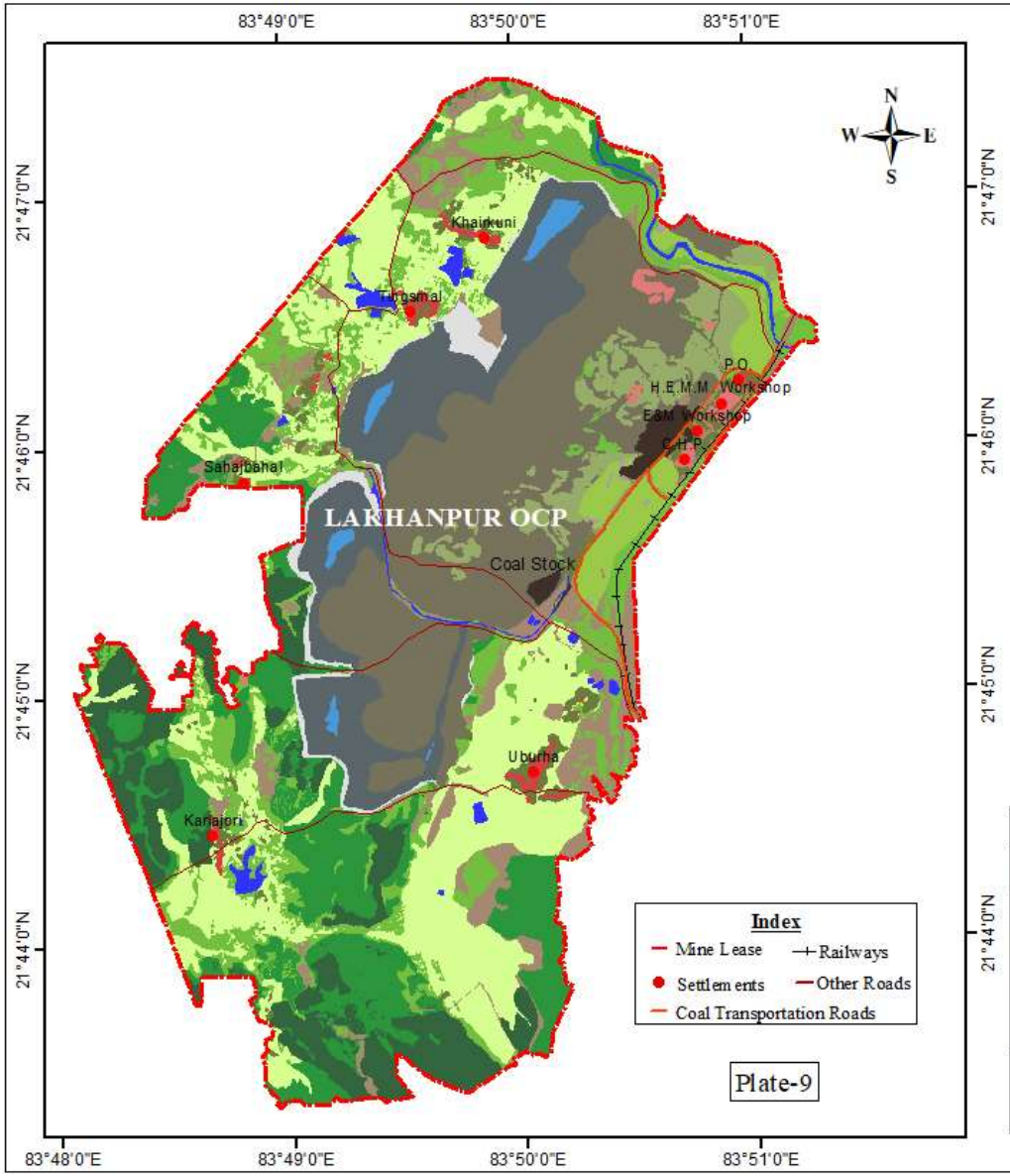

Area Statistics - Lakhanpur OCP (2019)

Classes		Colour	Area	
Level-I	Level-II		Area (Km^2)	% of Total
Forest Area	Dense Forest		1.78	7.95
	Open Forest		2.81	12.54
	Total Forest Area (A)		**4.59**	**20.49**
Scrubs	**Scrubs (B)**		**2.86**	**12.77**
Plantation	Social Forestry		0.45	2.01
	Plantation on Backfill		0.80	3.57
	Plantation on OB Dump		0.59	2.63
	Total Plantation (C)		**1.84**	**8.21**
	Total Vegetation(A+B+C)		**9.29**	**41.47**
Agriculture	**Agriculture Land**		**4.19**	**18.71**
Waste Land	**Waste Land**		**1.61**	**7.19**
Mining Area	Coal Quarry		2.04	9.11
	Barren OB Dump		0.02	0.09
	Area Under Backfilling		4.12	18.39
	Water Filled Quarry		0.15	0.67
	Coal Dump		0.14	0.63
	Advance Quarry Site		0.32	1.43
	Total Mining Area		**6.79**	**30.31**
Settlements	Rural Settlement		0.14	0.63
	Industrial Settlement		0.12	0.54
	Total Settlement Area		**0.26**	**1.16**
Water Body	**River, Ponds**		**0.26**	**1.16**
		Total	**22.40**	**100.00**

Customer	Mahanadi Coalfields Limited				
Title	Land Reclamation Monitoring of OC Projects				Job No. 561410027
Subject Land Reclamation Status of Lakhanpur OCP based on Satellite Data (RS-2/L-IV) of the year 2019	Activity	Name	Designation	Signature	Date
	Prepared	A. Biswas	Mgr.(Geology)	ABiswas	
	Checked	T. Mondal	CM(RSC)		
	Approved	R. Kumar	GM (Geomatics)		
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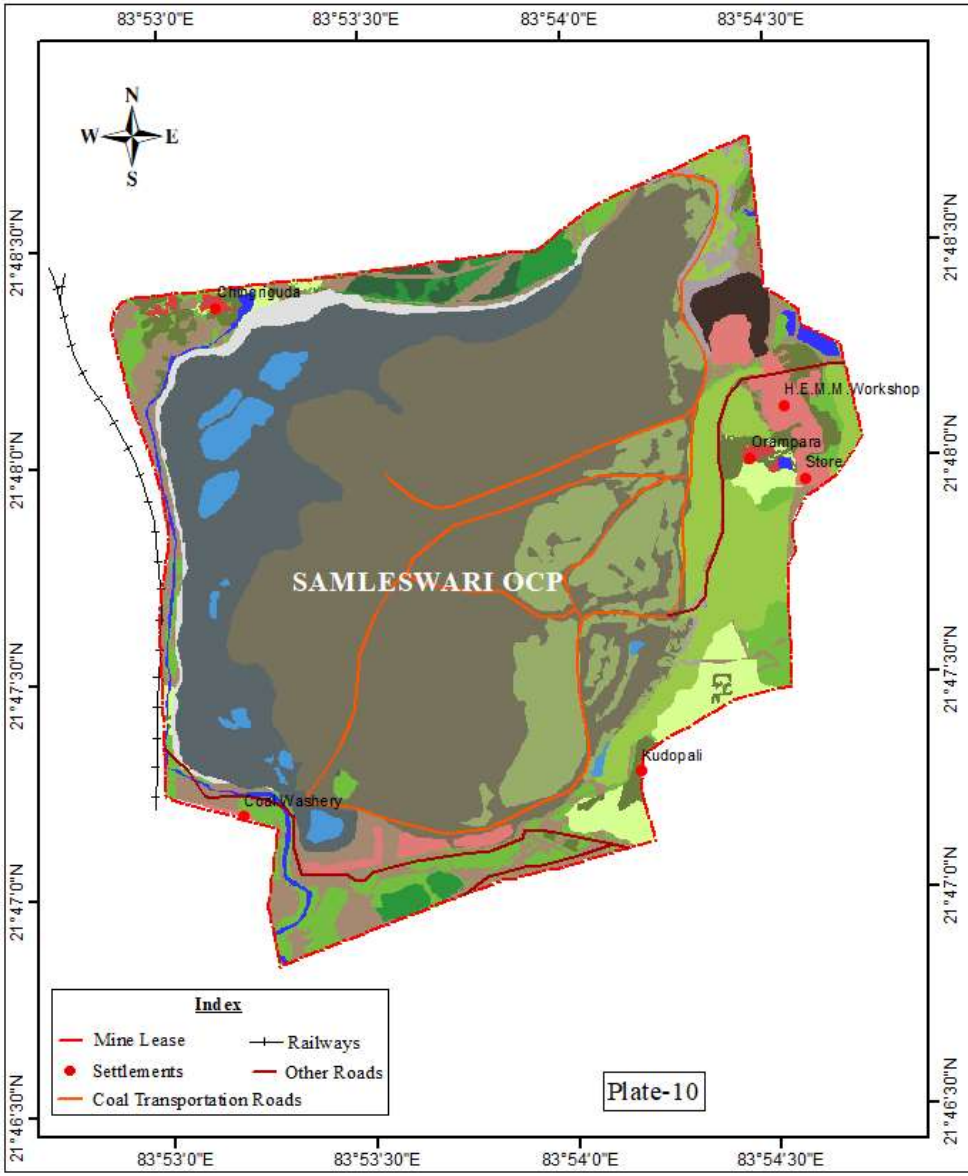

Area Statistics - Samleswari OCP (2019)

Classes		Colour	Area	
Level-I	Level-II		Area (Km^2)	% of Total
Forest Area	Dense Forest		0.05	0.70
	Open Forest		0.10	1.40
	Total Forest Area (A)		**0.15**	**2.10**
Scrubs	**Scrubs (B)**		**0.39**	**5.47**
Plantation	Social Forestry		0.16	2.24
	Plantation on Backfill		0.68	9.54
	Plantation on OB Dump		0.48	6.73
	Total Plantation (C)		**1.32**	**18.51**
	Total Vegetation(A+B+C)		**1.86**	**26.09**
Agriculture	**Agriculture Land**		**0.19**	**2.66**
Waste Land	**Waste Land**		**0.53**	**7.43**
Mining Area	Coal Quarry		1.00	14.03
	Barren OB Dump		0.07	0.98
	Area Under Backfilling		2.90	40.67
	Water Filled Quarry		0.14	1.96
	Coal Dump		0.07	0.98
	Advance Quarry Site		0.12	1.68
	Total Mining Area		**4.30**	**60.31**
Settlements	Rural Settlement		0.02	0.28
	Industrial Settlement		0.17	2.38
	Total Settlement Area		**0.19**	**2.66**
Water Body	**River, Ponds**		**0.06**	**0.84**
		Total	**7.13**	**100.00**

Customer	Mahanadi Coalfields Limited				
Title	Land Reclamation Monitoring of OC Projects				Job No. 561410027
Subject: Land Reclamation Status of Samleswari OCP based on Satellite Data (RS-2/L-IV) of the year 2019.	Activity	Name	Designation	Signature	Date
	Prepared	A. Biswas	Mgr(Geology)	ABiswas	
	Checked	T. Mandal	CM(RSC)		
cmpdi A Mini Ratna Company	Approved	R. Kumar	GM(Geomatics)		
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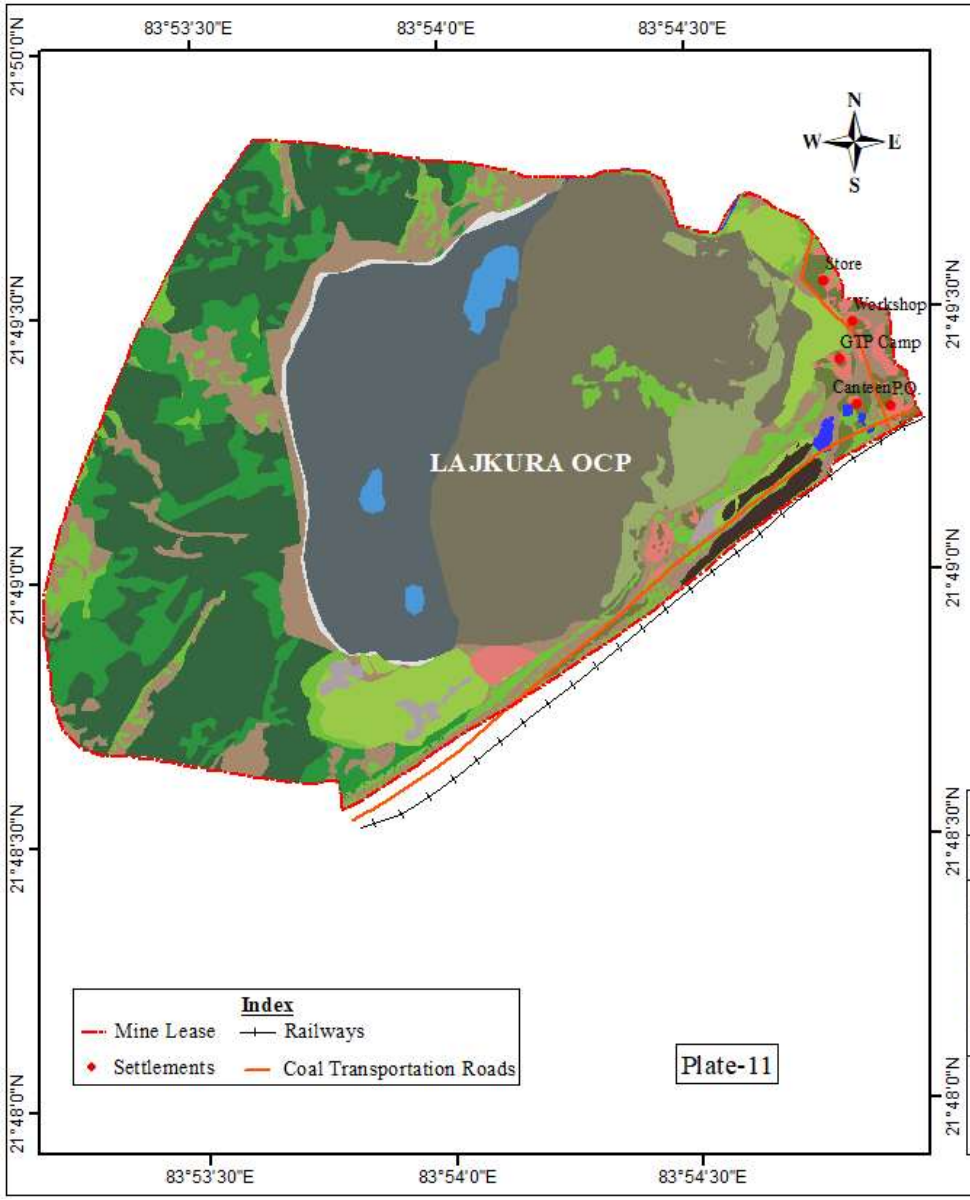

Area Statistics - Lajkura OCP (2019)				
Classes		Colour	Area	
Level-I	Level-II		Area (Km^2)	% of Total
Forest Area	Dense Forest		0.92	19.64
	Open Forest		0.43	9.18
	Total Forest Area (A)		**1.35**	**28.82**
Scrubs	**Scrubs (B)**		**0.27**	**5.76**
Plantation	Social Forestry		0.06	1.28
	Plantation on Backfill		0.16	3.42
	Plantation on OB Dump		0.22	4.70
	Total Plantation (C)		**0.44**	**9.39**
	Total Vegetation(A+B+C)		**2.06**	**43.98**
Agriculture	**Agriculture Land**		**0.00**	**0.00**
Waste Land	**Waste Land**		**0.48**	**10.33**
Mining Area	Coal Quarry		0.75	16.01
	Barren OB Dump		0.03	0.64
	Area Under Backfilling		1.15	24.55
	Water Filled Quarry		0.05	1.07
	Coal Dump		0.04	0.85
	Advance Quarry Site		0.04	0.85
	Total Mining Area		**2.06**	**43.98**
Settlement	Industrial		0.07	1.49
Water Body	**River, Ponds**		**0.01**	**0.21**
		Total	**4.68**	**100.00**

Customer	Mahanadi Coalfields Limited				
Title	Land Reclamation Monitoring of OC Projects				Job No. 561410027
Subject Land Reclamation Status of Lajkura OCP based on Satellite Data (RS-2/L-IV) of the year 2019	Activity	Name	Designation	Signature	Date
	Prepared	A. Biswas	Mgr.(Geology)	ABiswas	
	Checked	T. Mondal	CM(RSC)		
	Approved	R. Kumar	GM (Geomatics)		
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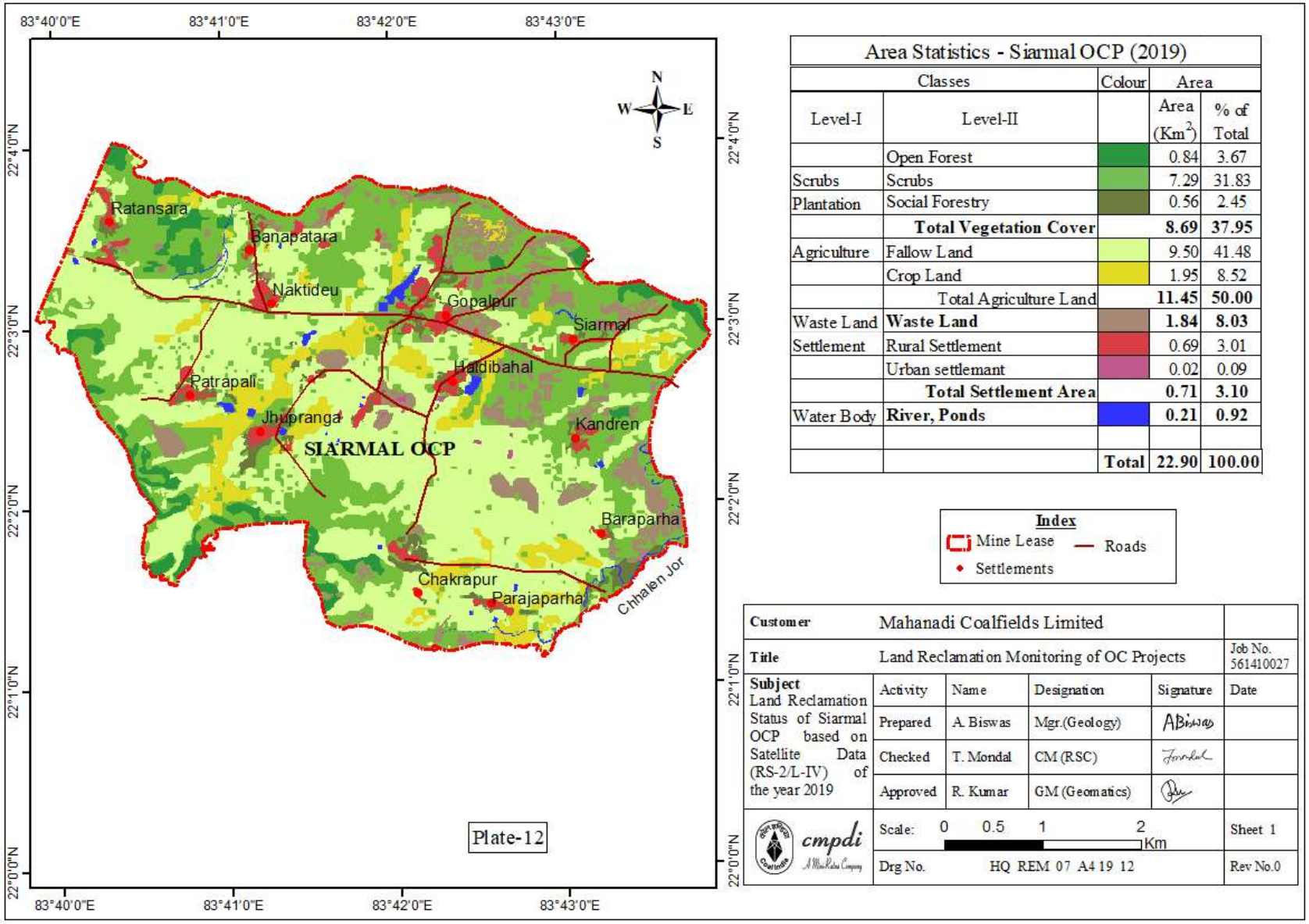

Area Statistics - Siarmal OCP (2019)				
Classes		Colour	Area	
Level-I	Level-II		Area (Km^2)	% of Total
	Open Forest		0.84	3.67
Scrubs	Scrubs		7.29	31.83
Plantation	Social Forestry		0.56	2.45
	Total Vegetation Cover		**8.69**	**37.95**
Agriculture	Fallow Land		9.50	41.48
	Crop Land		1.95	8.52
	Total Agriculture Land		**11.45**	**50.00**
Waste Land	**Waste Land**		**1.84**	**8.03**
Settlement	Rural Settlement		0.69	3.01
	Urban settlemant		0.02	0.09
	Total Settlement Area		**0.71**	**3.10**
Water Body	**River, Ponds**		**0.21**	**0.92**
		Total	**22.90**	**100.00**

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Mine Lease — Roads
Settlements

Customer	Mahanadi Coalfields Limited				
Title	Land Reclamation Monitoring of OC Projects				Job No. 561410027
Subject Land Reclamation Status of Siarmal OCP based on Satellite Data (RS-2/L-IV) of the year 2019	Activity	Name	Designation	Signature	Date
	Prepared	A. Biswas	Mgr.(Geology)	ABiswas	
	Checked	T. Mondal	CM (RSC)		
	Approved	R. Kumar	GM (Geomatics)		
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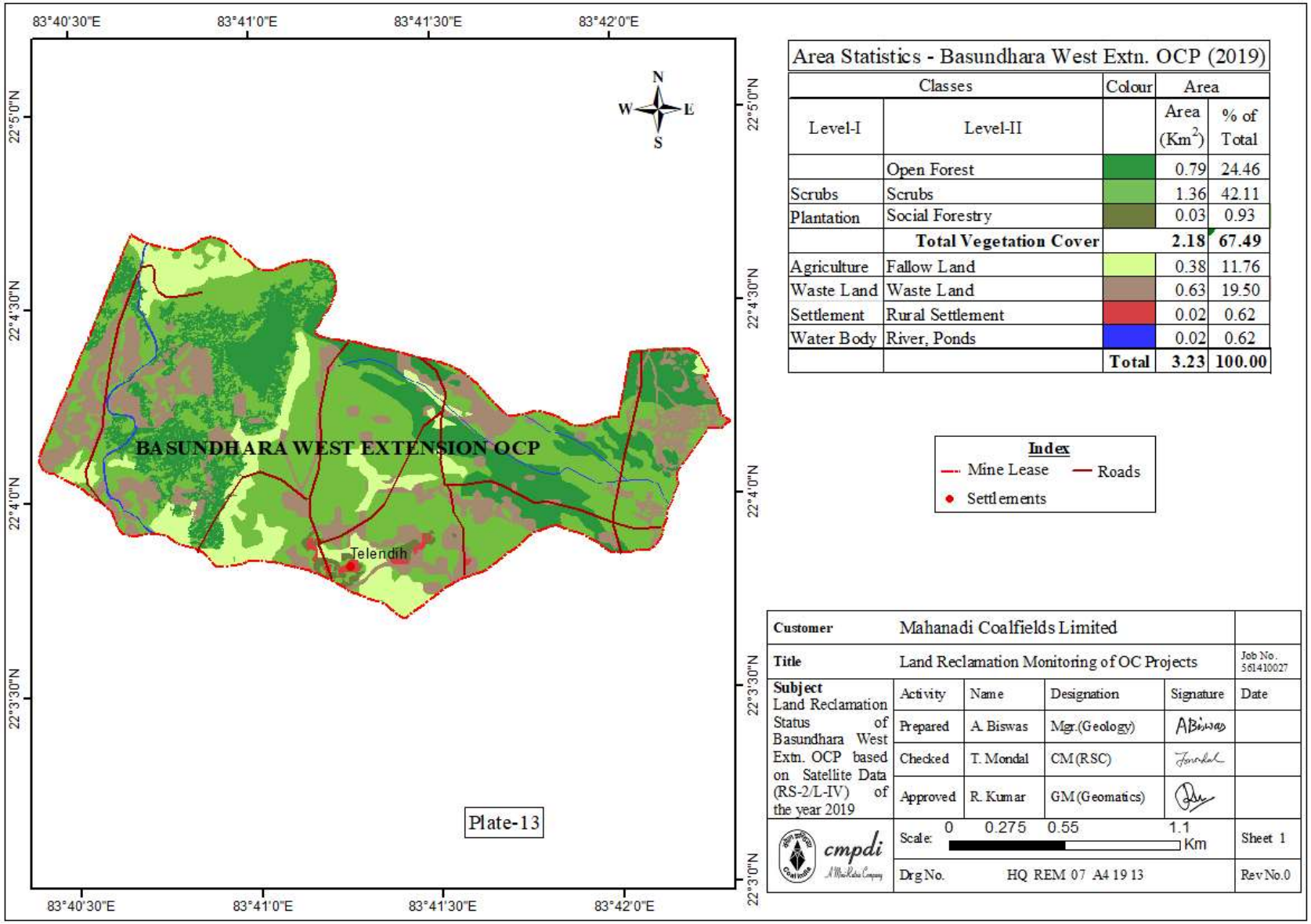

Area Statistics - Basundhara West Extn. OCP (2019)

Classes		Colour	Area	
Level-I	Level-II		Area (Km^2)	% of Total
	Open Forest		0.79	24.46
Scrubs	Scrubs		1.36	42.11
Plantation	Social Forestry		0.03	0.93
	Total Vegetation Cover		**2.18**	**67.49**
Agriculture	Fallow Land		0.38	11.76
Waste Land	Waste Land		0.63	19.50
Settlement	Rural Settlement		0.02	0.62
Water Body	River, Ponds		0.02	0.62
		Total	**3.23**	**100.00**

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Mine Lease — Roads
Settlements

Customer	Mahanadi Coalfields Limited				
Title	Land Reclamation Monitoring of OC Projects				Job No. 561410027
Subject Land Reclamation Status of Basundhara West Extn. OCP based on Satellite Data (RS-2/L-IV) of the year 2019	Activity	Name	Designation	Signature	Date
	Prepared	A. Biswas	Mgr.(Geology)	ABiswas	
	Checked	T. Mondal	CM(RSC)		
	Approved	R. Kumar	GM(Geomatics)		
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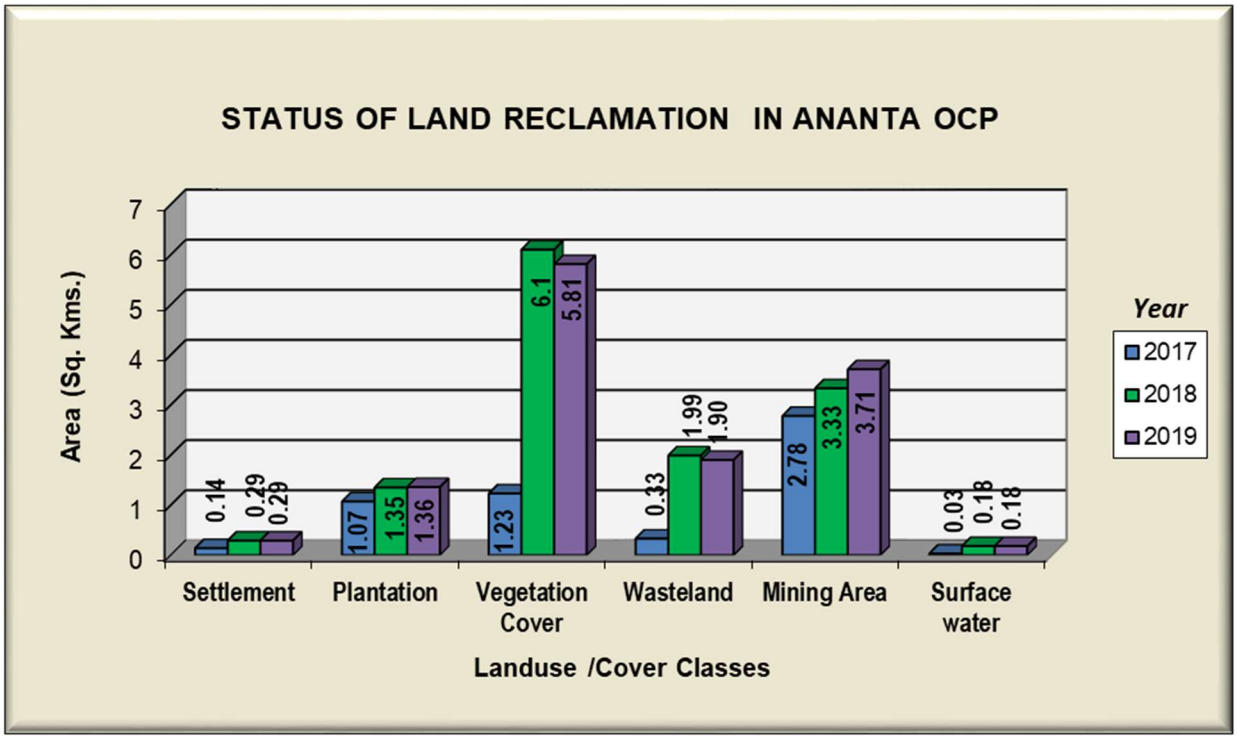

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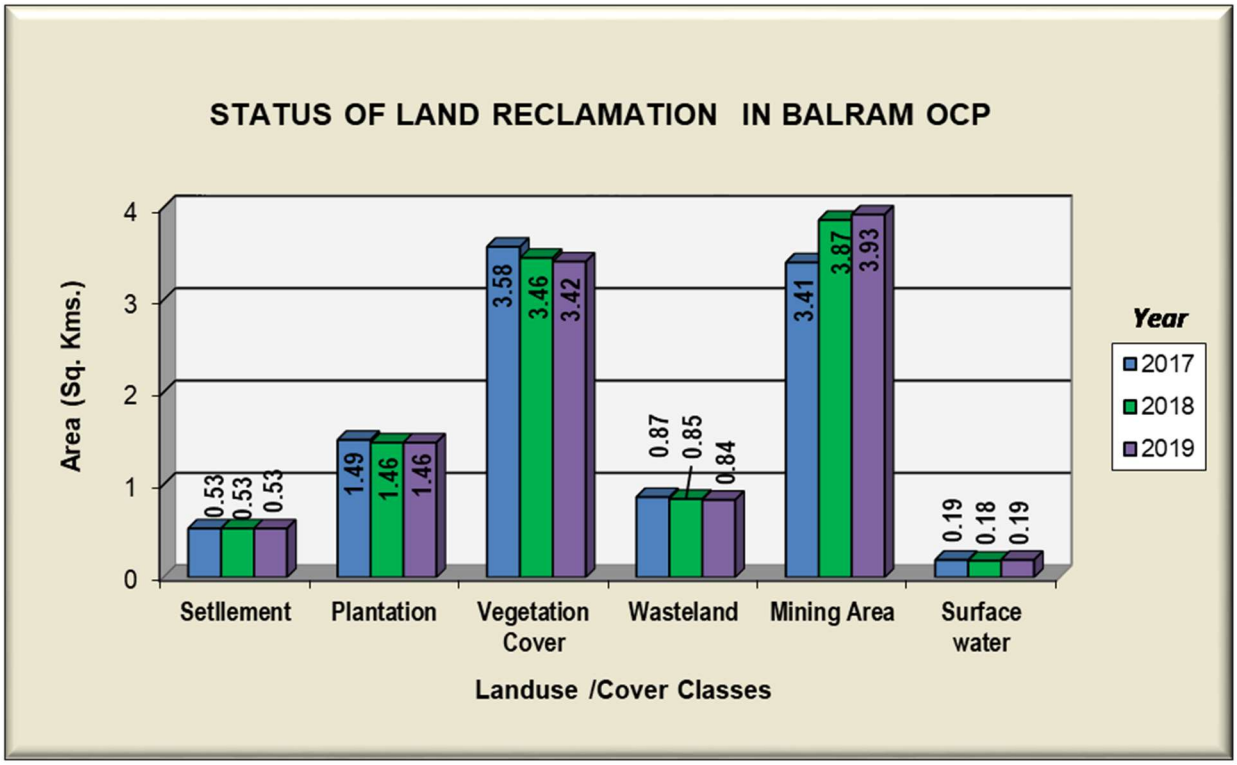

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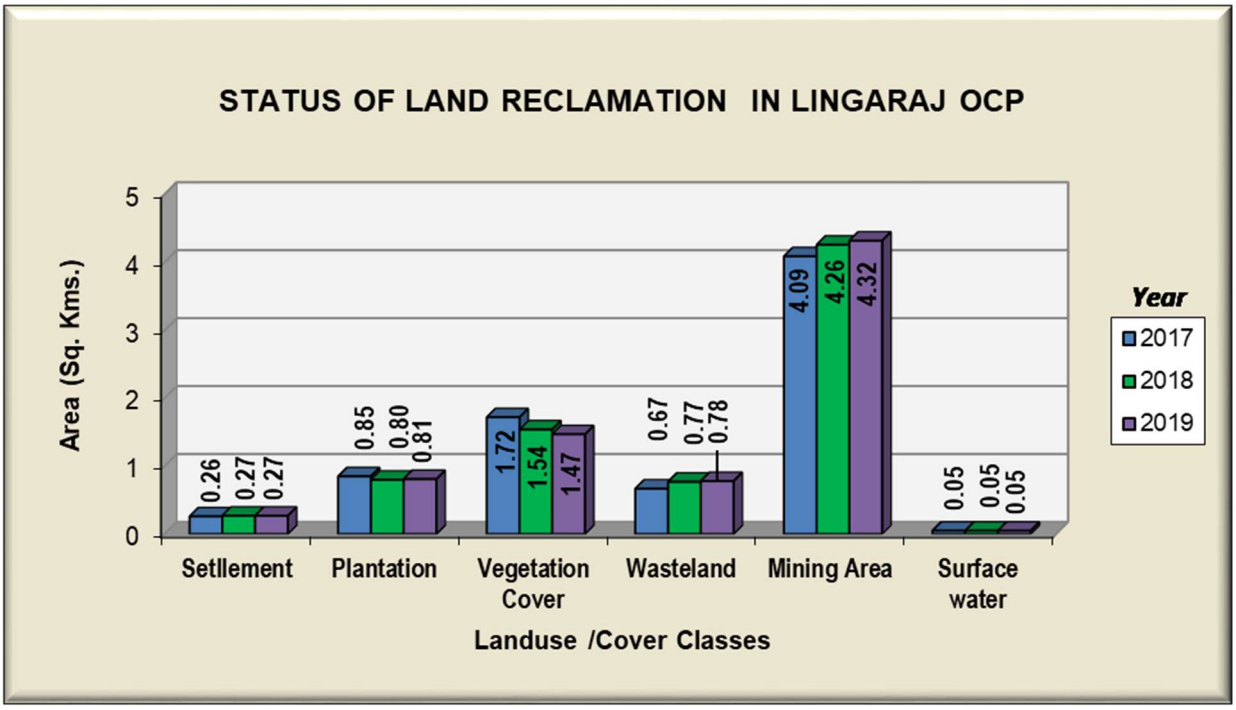

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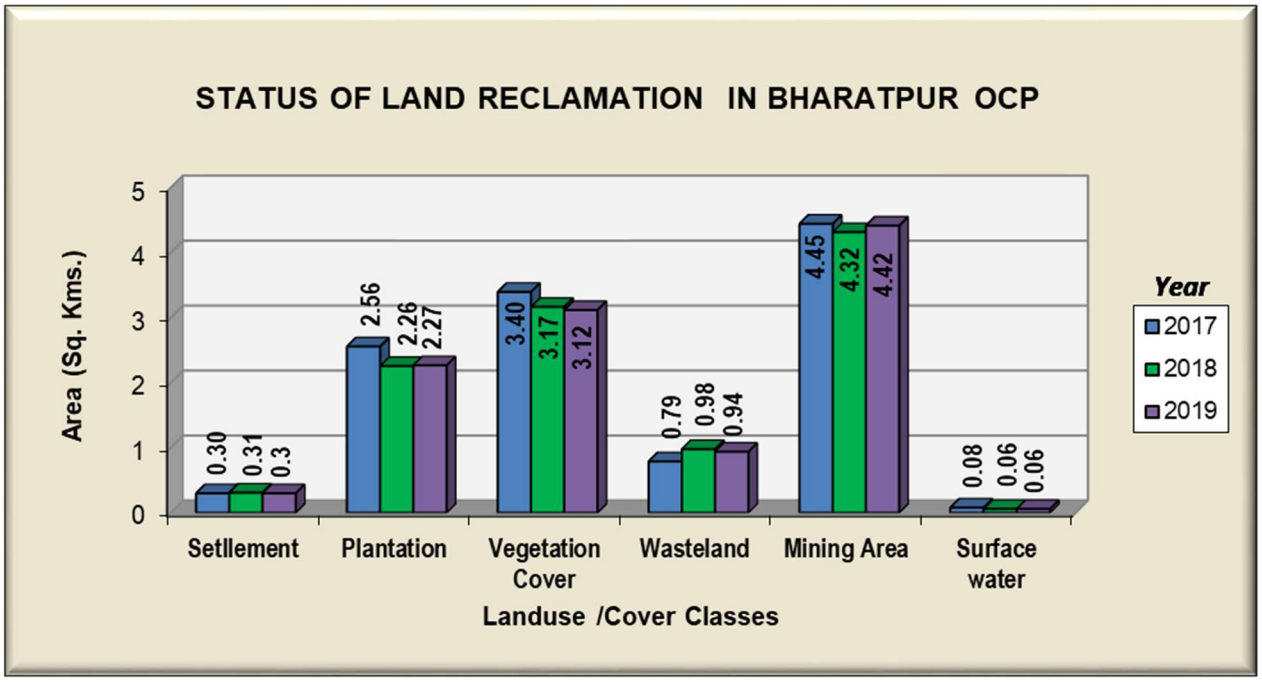

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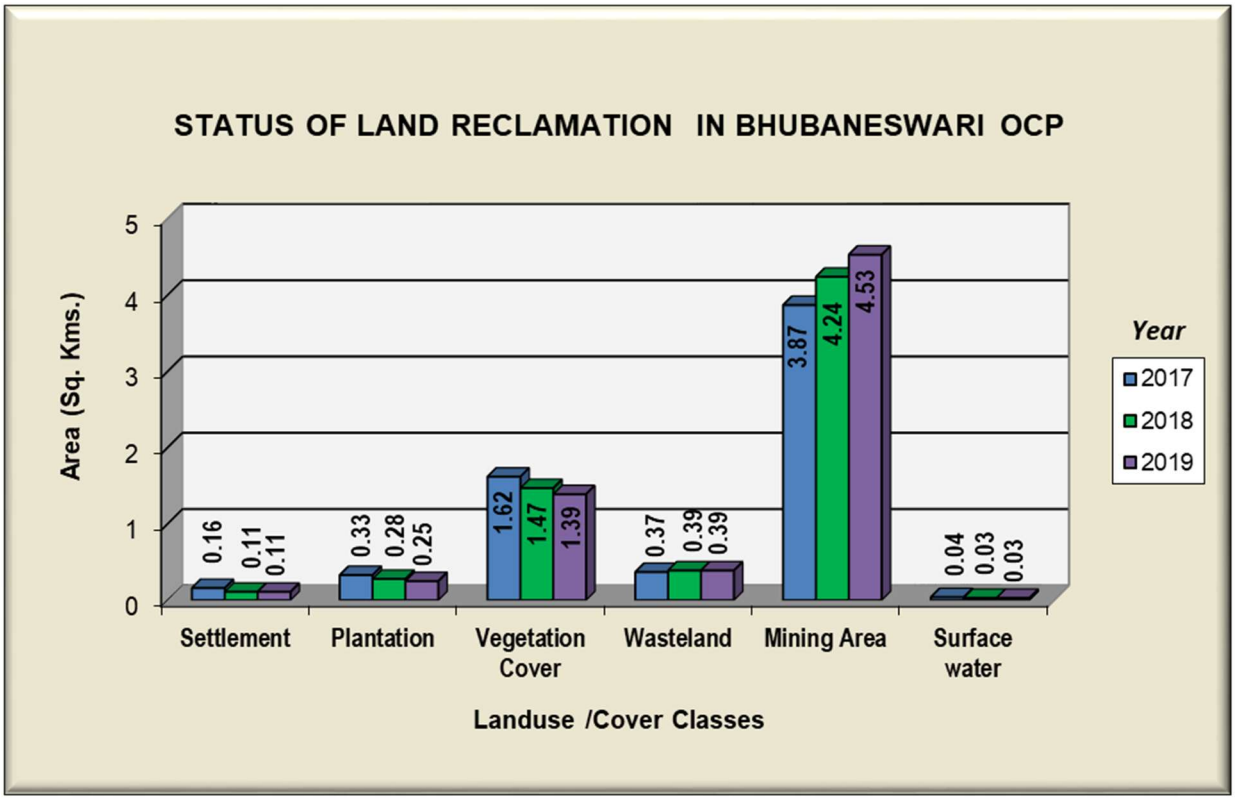

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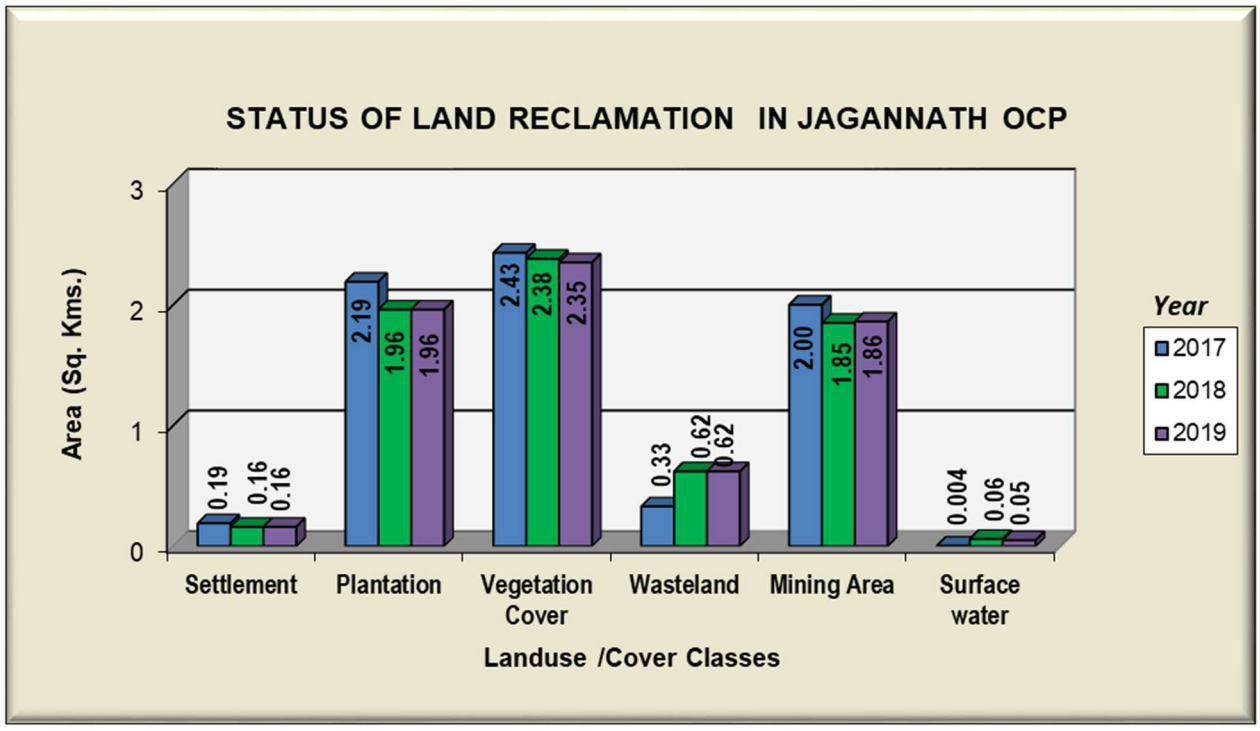

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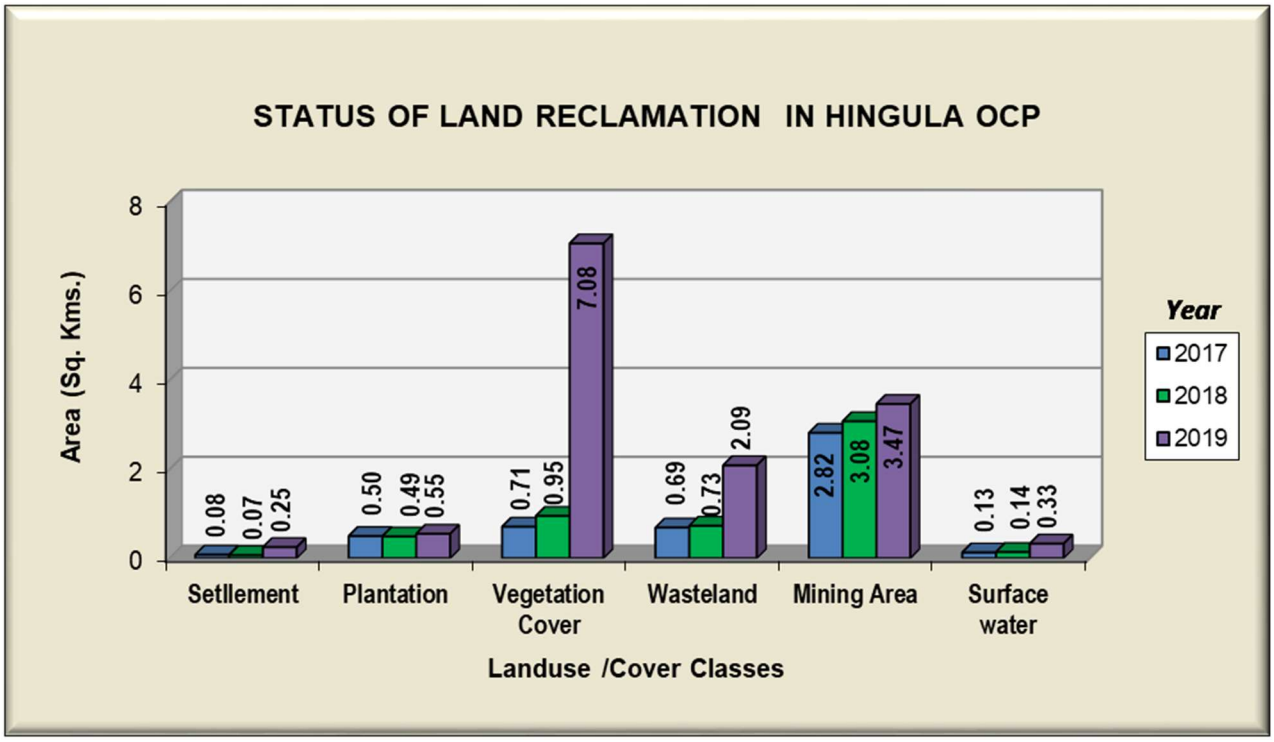

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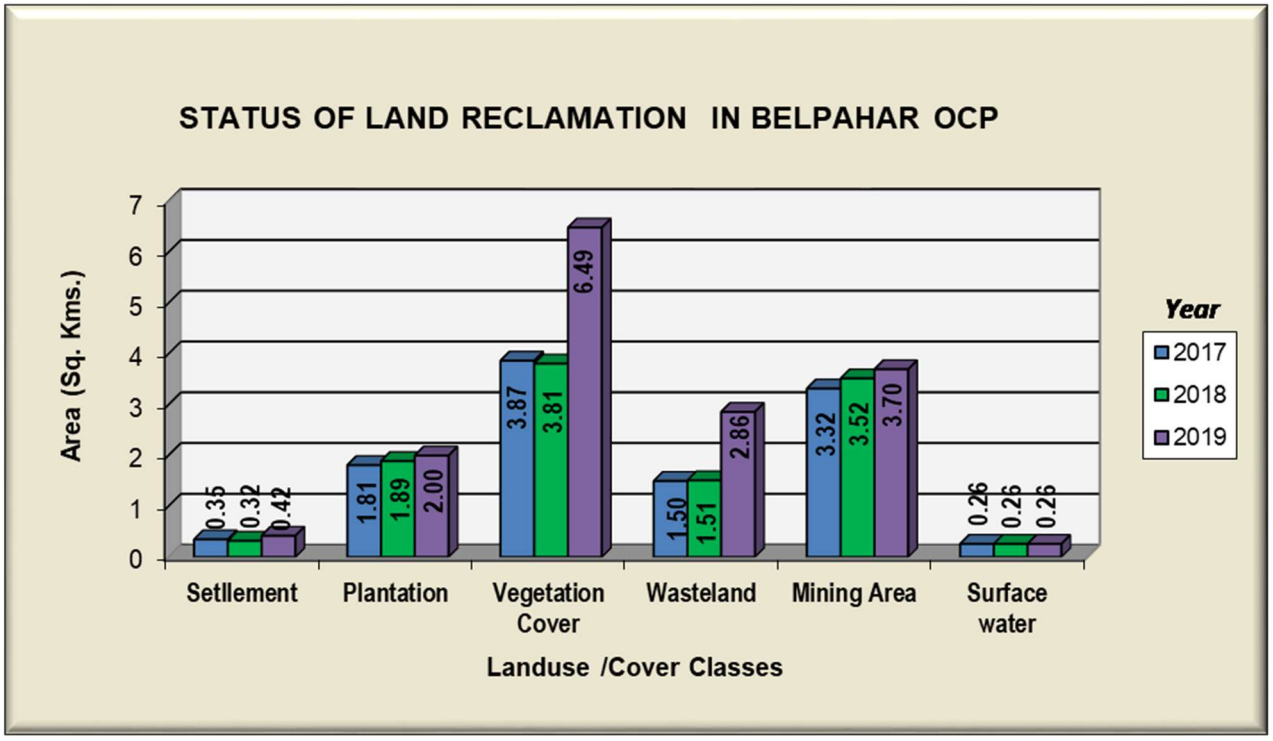

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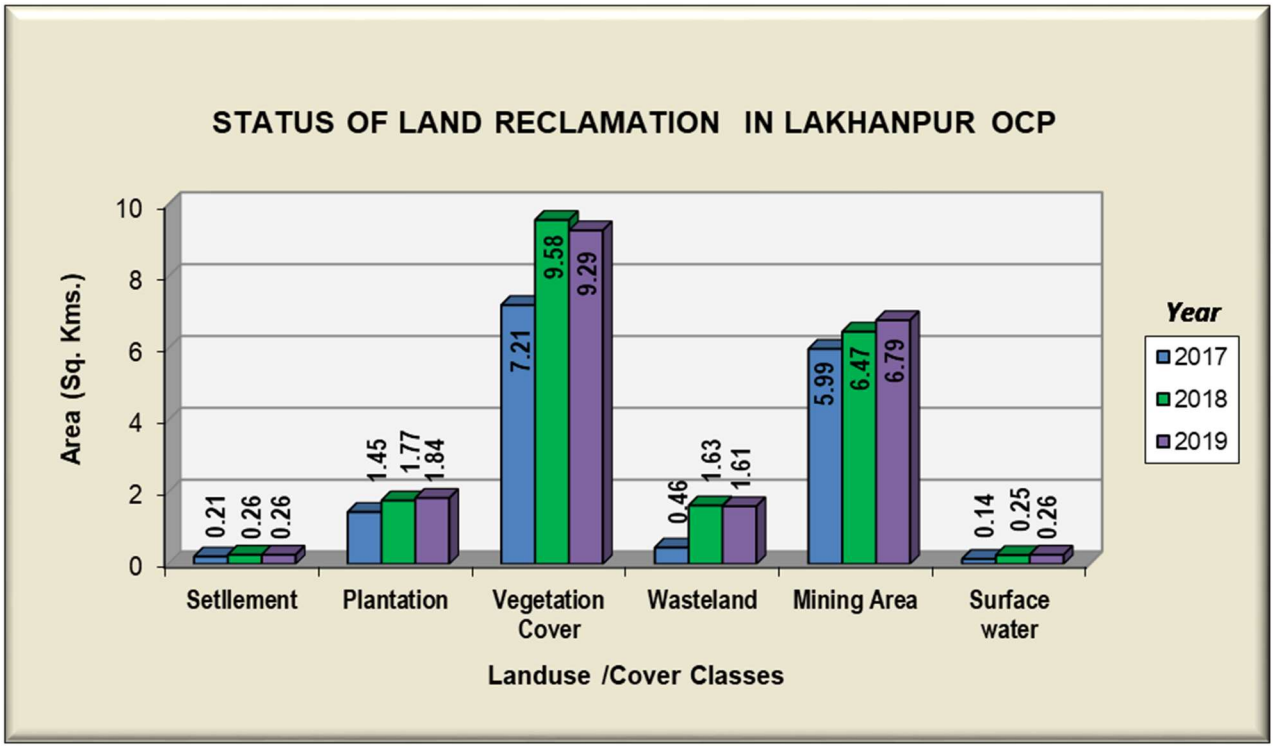

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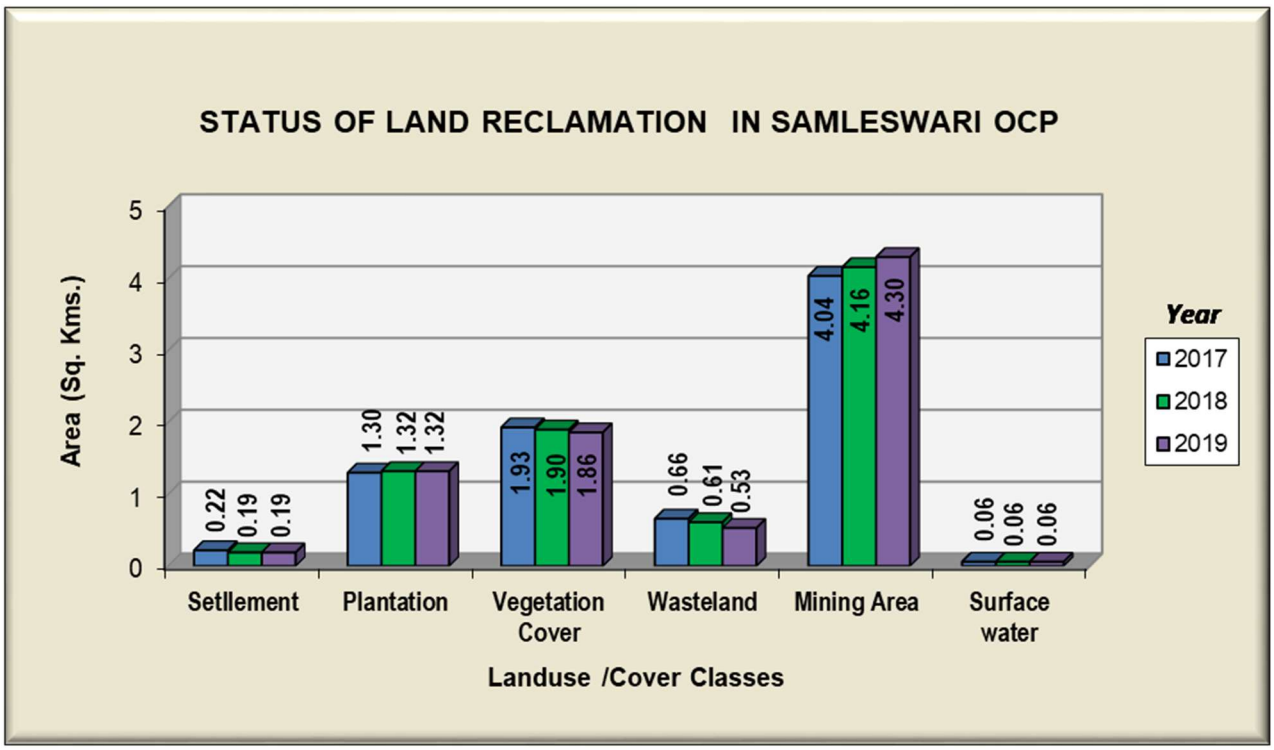

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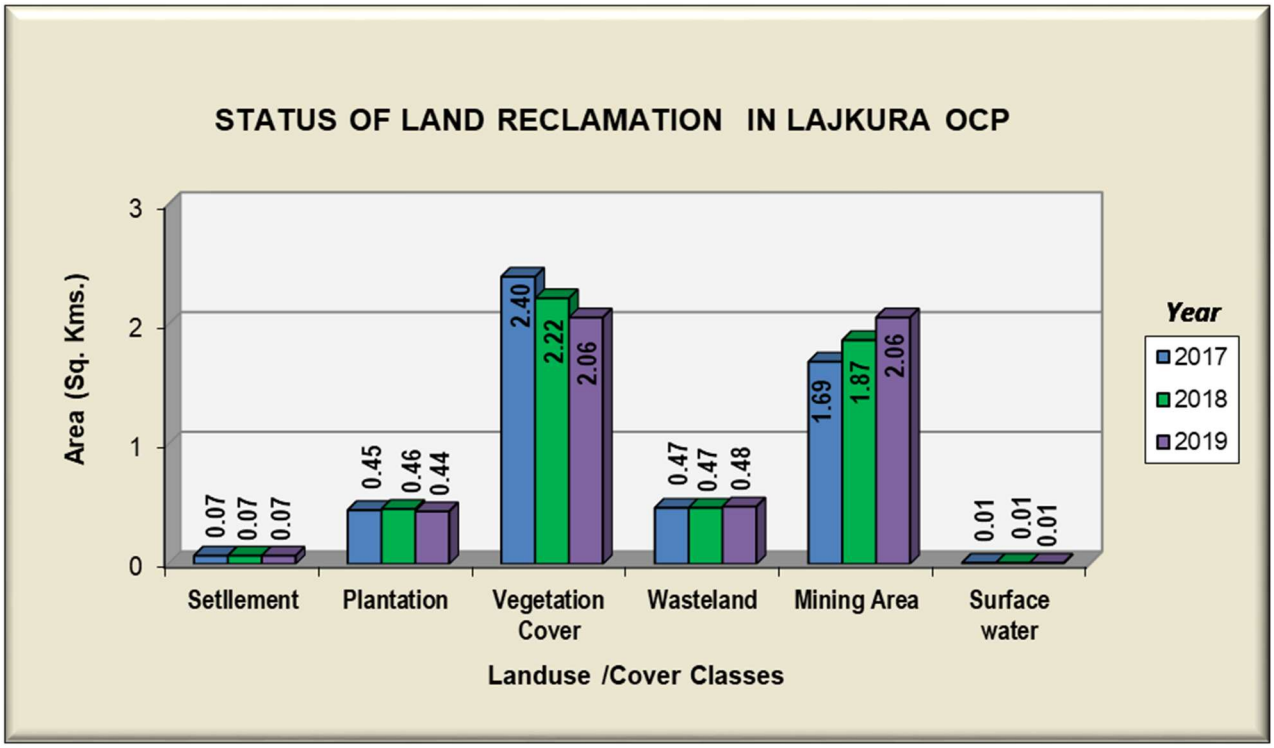

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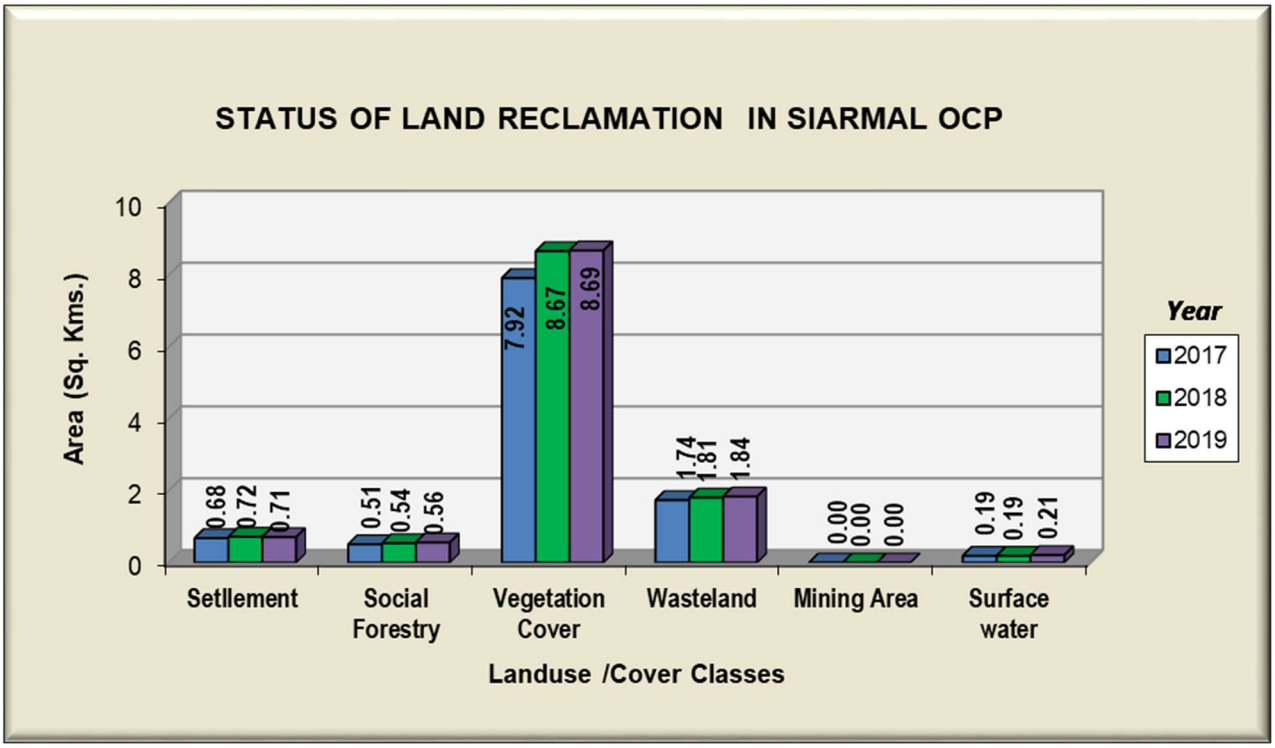

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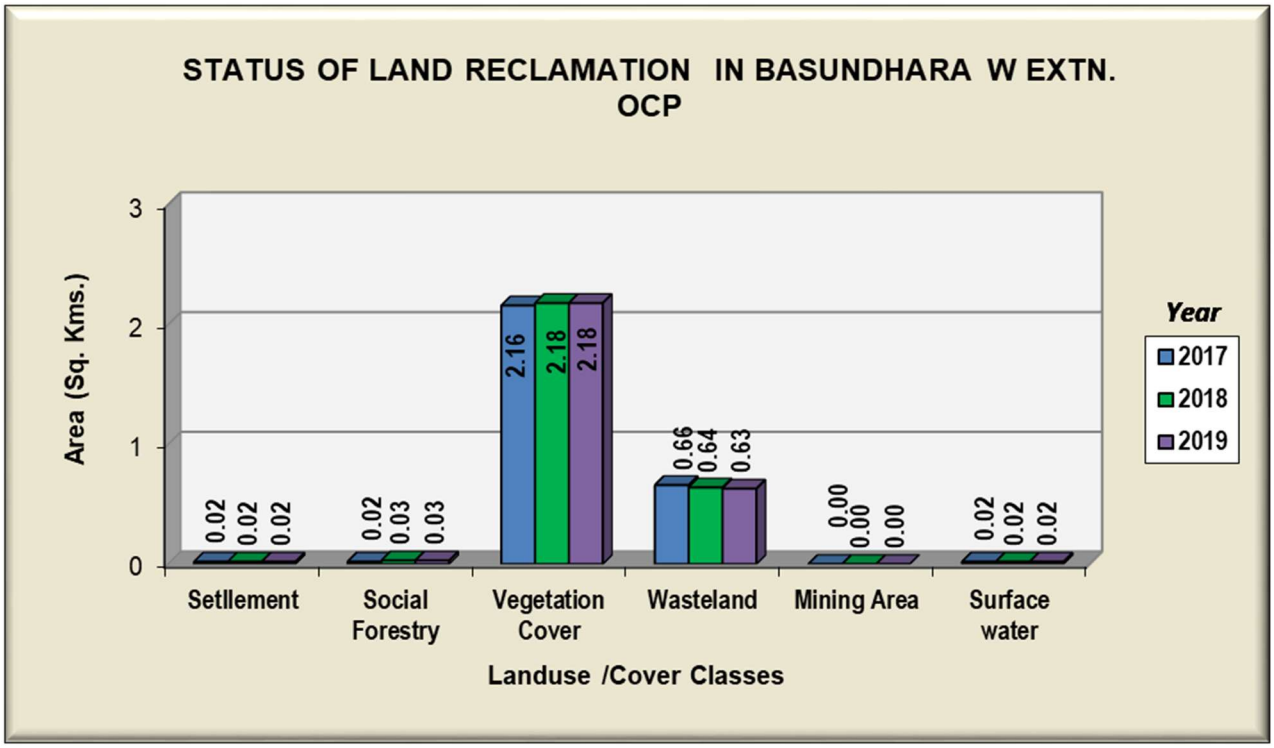
STATUS OF LAND RECLAMATION IN BASUNDHARA W EXTN. OCP
Area (Sq. Kms.)
3
2
1
0
0.02
0.02
0.02
0.02
0.03
0.03
2.16
2.18
2.18
0.66
0.64
0.63
0.00
0.00
0.00
0.02
0.02
0.02
Setllement
Social Forestry
Vegetation Cover
Wasteland
Mining Area
Surface water
Landuse /Cover Classes
Year
2017
2018
2019

Figure 15

Photograph-1: Plantation on Internal OB/Backfill (Ananta OC mine)

Photograph-2: Plantation on Internal OB/Backfill (Balram OC Mine)

Photograph-3: New Plantation Site (Lingaraj OC Mine)

Photograph-4: Plantation on Internal OB/Backfill (Bharatpur OC Mine)

Photograph-5: Plantation on Internal OB/Backfill (Jagannath OC Mine)

Photograph-6: Plantation on Internal OB/Backfill (Hingula OC Mine)

Photograph-7: Plantation on Internal OB/Backfill (Belpahar OC Mine)

Photograph-8: Plantation on Internal OB/Backfill (Lakhanpur OC Mine)

Photograph-9: Plantation on Internal OB/Backfill (Samleswari OC Mine)

Photograph-10: Plantation on Internal OB/Backfill (Lajkura OC Mine)

Central Mine Planning & Design Institute Ltd.
(A Subsidiary of Coal India Ltd.)
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Website : www.cmpdi.co.in, Email : cmpdihq@cmpdi.co.in