

The Impact of Bauxite Mining on the Physical Environment of Western Maharashtra, India

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Abstract The government has leased 33 bauxite mining projects in western Maharashtra. In reality the number of mines at work are 28. A large number of bauxite mines, 16 to be precise are located in the Kolhapur district and 12 mines are located in Konkan region, which is in the districts of Raigad (7) and Ratnagiri (5). Tehsilwise distribution reveals that maximum number of mines are located in Shahuwadi tehsil (10) of Kolhapur district which is followed by the tehsils of Shriwardhan (6), Chandgad (3), Dapoli (3), Radhanagari (2), Mandangad (2), Bhudargad (1) and Pen (1). Villages which fall within 2 km radius are the mining affected villages. The total excavated areas of mines 7697077 sq.mts, the depths of all these mines are found up to 4 to 9 meters. Total volume of excavated landmass that is 41029443 cubic meter land has been excavated in Maharashtra in order to get bauxite. Bulk density for mines of Konkan was found to be 1.670 tonne per cubic meter. Whereas bulk density of mines in the Sahyadri was 1.676 tonne per cubic meter. Up till 68696115.41 tonnes of earth materials have been excavated from the bauxite mines of the Western Maharashtra. Stripping ratio of bauxite mines of India is 1.281. It means out of total earth materials 54.55 % waste dump material is created. Such waste materials are mounted / dumped near the mining areas. A total of 27478446 tonnes bauxite has been produced and 41217669 tonnes of Waste Earth Materials generated in Western Maharashtra. In Western Maharashtra, the government has sanctioned 4784.13 hector lands for bauxite mining projects. Out of this area, 1496.88 hector land, mean 31.29% are under forest.

Keywords: *bauxite mining, excavated landmass, bulk density, waste dump material, bauxite production, forest fragmentation*

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1. Introduction

The impact of mining activities on pollution of air, water, land, soil quality, vegetation including forest ecosystems, and on human health and habitation has become a matter of serious concern. Any deterioration in the physical, chemical, and biological quality of the environment affects human health, flora and fauna. Mining and its subsequent activities have been found to degrade the land to a significant extent. Overburden removal from the mine area results in a very significant loss of rain forest and the rich top soil. Opencast mines are therefore more pollution intensive as they generate much higher quantities of waste compared to the underground mines [1]. Land degradation is one of the significant impacts arising out of mining and quarrying activity which is mainly in the form of alteration of land structure due to excavation, stacking of top soil and loss of land due to dumping of mine waste and overburden soil [2]. Mining activities around the world have been accompanied by land expropriation and

environmental degradation that harms the livelihoods and health of local communities [3].

The ratio of overburden excavated to the amount of mineral removed is called the overburden ratio or stripping ratio. For example a stripping ratio of 4:1 means that 4 tons of waste rocks are removed to extract one tons of ore [4]. The overburden ratio for surface mining of metal ores generally ranges from 2:1 to 8:1 depending on local conditions [5]. The ratio for solid wastes from underground mining is typically around 0.2:1 [6]. According to the data generated by the Indian Bureau of Mines, average stripping ratio for limestone mines in India is 1:1.05. For large-scale cement sector with captive mines, the average stripping ratio is only 1:1.05. This is quite good; however, the generation of overburden varies from mine to mine. It is as high as 1.363 tons per ton of limestone in case of Madras Cement Limited: KSR Nagar Jayantipuram to 544 kgs per tonne of limestone in case of ACC's unit at Jamul [4]. For iron ore mines, the stripping ratio ranges around 1:2-2.5 [7]. In 2003-04 itself, SAIL generated 4.76 million tons of overburden and rejects from its 12 mines in the country [8].

Opencast mines of North Eastern Coalfields in Assam over the past century have been producing waste rock at a stripping ratio of 1:14 [9]. The coal mines of Coal India Limited (CIL) removed about 500 million cubic m (Mcum) of overburden (OB) to produce 260 MT of coal in 2003-04 at an average stripping ratio of 1.92 cu m of OB against per ton of coal production [10]. Bauxite ores in India are harder and have a higher stripping ratio when compared to the Australian counterpart [11]. Indian bauxite has a stripping ratio of around 1.2 as compared to only 0.13 in Australia [12]. The main air quality issue with mining is dust particles [13]. Large amounts in concentrations of dust can be a health hazard, exacerbating respiratory disorders such as asthma and irritating the lungs and bronchial passages. However, people invariably feel a loss of environmental amenity, due to dust deposits or dust concentration, before their health is affected [14].

Mining operations can affect ground water quality in several ways. Noise pollution associated with mining may include noise from vehicle engines, loading and unloading of rock into steel dumpers, chutes, power generation, and other sources [15]. Mining can acidify the soil and water, increase toxic chemical availability, and increase siltation of water and leaf surfaces. These effects in turn are known to decrease water availability, decrease plant growth, and as a result, decreased wildlife abundance and diversity [16,17,18,19,20].

Changes to an existing slope may create environmental problems associated with increased erosion, rapid runoff, changes in wildlife patterns and the exposure of potentially reactive natural materials. Mining and quarrying, either open cast or underground, destroys

landscape and forest ecosystem. The waste materials that remain after the extraction of usable ores are dumped on the surrounding land, thus causing loss of topsoil, nutrients and supportive micro flora and vegetation [15]. The exact effects of bauxite mining are quite specific to the site. It nearly always involves some habitat destruction, soil erosion, loss of biodiversity, or water pollution. The deforestation and soil erosion can lead to problems associated with flooding, including wastewater being swept into the drinking supply [21].

2. Study Area

The study area consists of bauxite mining sites of Western Maharashtra. It includes three districts which are Kolhapur, Raigad and Ratnagiri (Figure 1). In Western Maharashtra overall twenty eight bauxite mines have been observed. Out of those, sixteen are located in the Sahyadri especially in Kolhapur whereas twelve are located in the Konkan especially in Raigad and Ratnagiri. In Maharashtra Bauxite deposits are found in Kolhapur, Raigad, Ratnagiri, Satara, Sindhudurg and Thane districts. But most of the mining lease has been in operation more than two decades at three districts of western Maharashtra. In Kolhapur district Shahuwadi (10 mines), Radhanagari (03 mines), Chandgad (04 mines) and Bhudargad (01 mine); In Raigad district Shrivardhan (06) and Pen (01); In Ratnagiri district Dapoli (03) and Mandangad (03) [22]. These are the major bauxite mining sites of western Maharashtra. All government sanctioned bauxite mines and its affected area of western Maharashtra is the study area of present research work (see Figure 1).

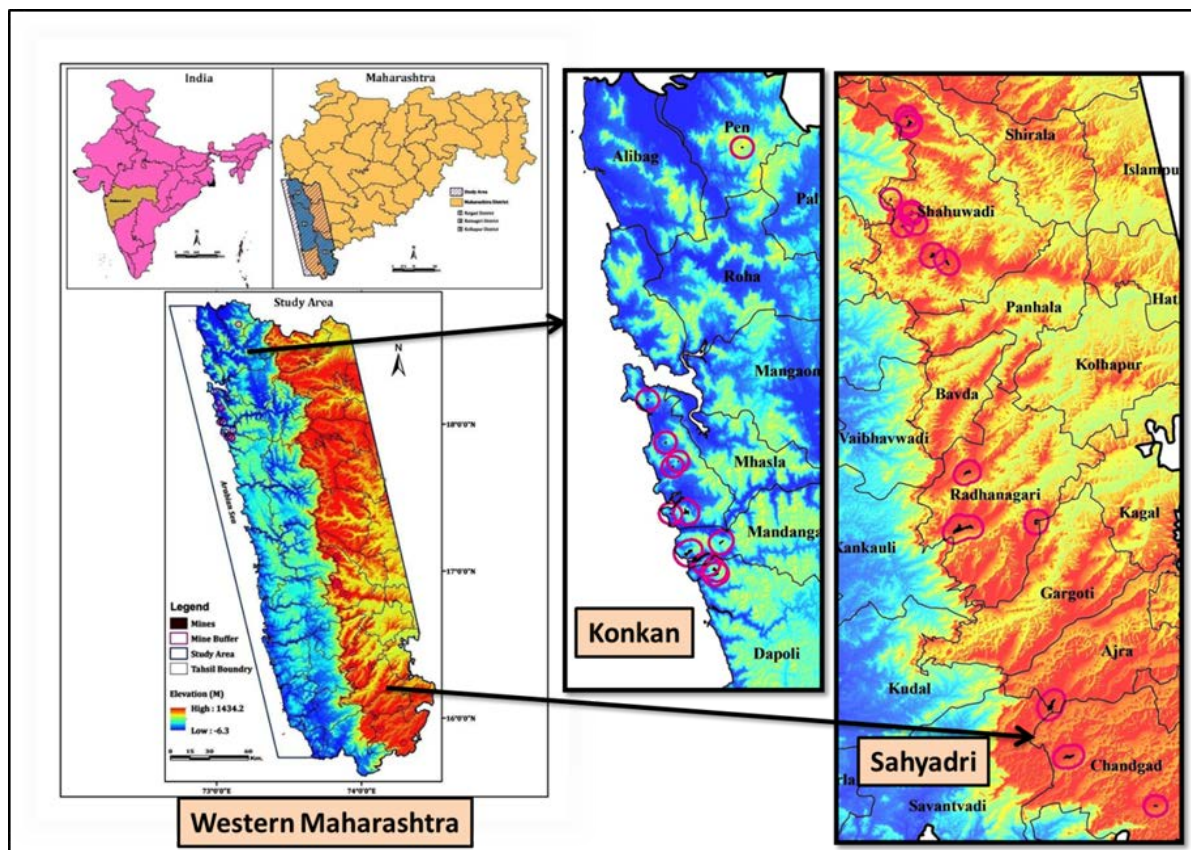


Figure 1. Study Area

3. Methodology

The information about bauxite mining projects, which were leased by government of Maharashtra in western region was obtained from Indian Bureau on Mines, Nagpur, and district collector office of Kolhapur. Out of sanctioned projects how many mines are in operations have been identified with the help of 'google earth images' where bauxite mines are actual leased on. Along with this, the information has been verified by actually visiting the leased area. With the help of following criteria bauxite mining affected area has been decided as area within 2 km from the periphery of a mine.

- Foot print of the bauxite mining activity has been clearly seen up to 2 km.
- Dust generated during mining activity is settled within 2 km of the mine.
- Sound generated due to mining is clearly heard up to 2 km.
- Mining activity is the daily experience of villagers living within 2 km from mine.
- Villages falling within 2 km are the owners of mine land.

With the help of above points, areas falling within 2 km radius from mine and the villages which come within these 2 km area have been decided as mining affected area. Information on area excavated for bauxite mining was obtained using different approach. For this following method was adopted

- Extraction of mine area through shape files from Bhuvan and Google Earth images.
- Importing the extracted shape files in GIS software.
- Measuring the mining area by polygon digitization.

After measuring the area of each bauxite mine of western Maharashtra, the depth of each mine and land that was excavated was estimated. The depth of each mine and the area covered was confirmed by visiting the actual site.

- Depth of ten different pits located within the same mine was measured with the help of local people.
- Average of these ten different pits was computed for each mine.

Before initiating mining activity each company has to submit Environmental Impact Assessment Report, which mentions the depth of mine that is required to excavate bauxite. This information on depth was collected from Environmental Impact Assessment and was later checked on ground by visiting the actual site. With the help of area of excavated land and its depth overall volume of excavated landmass is identified for mines of western Maharashtra. For this, simple mathematical equation is used.

$$A \times D = V$$

A = Area of Excavated Landmass (in Square Meters)

D = Depth of Excavated Landmass (in Meters)

V = Volume of Excavated Landmass (in Cubic Meters)

At the place of mine, excavated earth materials have been measured in order to find out materials excavated from each bauxite mine. For this task, six inch cube was prepared. In such a cube, mine excavate materials were filled completely and its weight was measured. This

experiment gave a general idea the material contained in the cube. Even bulk density of mined land material was checked out from Mechanical Department of Sanjivanni Engineering College, Kopergaon in order to prove it more scientifically. Bulk density was measured separately for Konkan and Sahyadri mines. From these experiment the amount of land material excavated from bauxite mines of Maharashtra was computed. Out of this the amount of waste material was estimated using stripping ratio. The ratio of overburden excavated to the amount of mineral removed is called stripping ratio [23]. Through this method we can understand that out of total excavated mine land materials of Indian mining sector 54.55% are waste materials and 45.45% are bauxite ore [23].

Total amount of bauxite produced in Maharashtra was obtained from Indian Minerals Year book. In the present study with the help of volume of land mass, total excavated earth materials, stripping ratio of Indian bauxite mine sector mine wise production of bauxite was calculated. According to the stripping ratio of the Indian bauxite mining sector 45.45% of bauxite ore is extracted from the total earth material that is excavated. In the present research all bauxite mines of Maharashtra have been considered for the study. Mine wise bauxite production was calculated through Stripping Ratio and the mine wise cumulative value of all mines in the state of Maharashtra indicates total production.

4. Results and Discussion

The government has leased 33 bauxite mining projects in western Maharashtra (Table 1). It has been noticed that in Kolhapur district date of first original leased grant is 02.10.1968 whereas its period for its grant is from 21/5/1998 to 20/5/2018. In Raigad district; date of first original leased grant is 08/03/1978 whereas its period is from 13/12/1998 to 12/12/2018. In Ratnagiri district date of first original leased grant is 07/08/1968 whereas its period for grant is from 29/11/89 to 28/11/2009. In Sindhudurg district date of first original leased grant is 10/02/1968 whereas its period for grant is from 23/5/1968 to 22/5/1998. In Maharashtra, the government has leased only these four districts for bauxite mining projects. Through this information, it has been understood that in Maharashtra, before 1968, no mining project has been leased by the government. In brief, it means before 1968 there was no bauxite excavation registered.

Maharashtra state government leases for bauxite mining were granted in the districts of Kolhapur (16), Raigad (9), Ratnagiri (7), Sindhudurg (1). Kolhapur district ranks first in bauxite mining projects whereas Raigad at ranks second and Ratnagiri is at third position. If one studies tehsilwise information of bauxite mining projects, it is observed that the leased mines are located in Shahuwadi (10), Shrivardhan (8), Dapoli (4), Mandangad (2), Chandgad (3), Radhanagari (2), Bhudargad (1), Pen (1), Sawantwadi (1) and Rajapur (1). Though government has above-mentioned leases, in reality the number of mines at work are 28 (Table 2a and Table 2b).

Table 1. Mining Leases for Bauxite Minerals for the Year Ending 31/3/2014 in the Maharashtra State

| S.N | Name of the lessee | Tehsil | Date of Original lease grant | Period for which granted | Total Period |
|----------------------------|----------------------------------|-------------|------------------------------|--------------------------|--------------|
| Kolhapur District | | | | | |
| 1 | M/s Hindalco Industries Ltd. | Chandgad | 02/10/1968 | 21/05/1998 to 20/05/2018 | 20 |
| 2 | M/s Hindalco Industries Ltd. | Chandgad | 02/10/1968 | 21/05/1998 to 20/05/2018 | 20 |
| 3 | M/s Hindalco Industries Ltd. | Chandgad | 02/10/1968 | 21/05/1968 to 20/05/1998 | 30 |
| 4 | M/s Hindalco Industries Ltd. | Radhanagari | 02/10/1968 | 21/05/1998 to 20/05/2018 | 20 |
| 5 | M/s Hindalco Industries Ltd. | Radhanagari | 02/10/1968 | 21/05/1998 to 20/05/2018 | 20 |
| 6 | Shri V.K. Vatkar, | Shahuwadi | 02/10/1968 | 01/04/2001 to 31/03/2021 | 20 |
| 7 | M/s Swati Minerlas | Shahuwadi | 19/07/1985 | 20/06/1995 to 19/06/2015 | 20 |
| 8 | Prakash Ananadrao Gaikwad | Shahuwadi | 16/10/1999 | 30/09/2000 to 29/09/2020 | 20 |
| 9 | M/s Bhartesh Construction Com. | Shahuwadi | 20/06/2000 | 08/12/2000 to 07/12/2030 | 30 |
| 10 | M/s Panditrao mines & Minerals | Bhudargad | 02/01/2001 | 30/10/2003 to 29/10/2033 | 30 |
| 11 | M/s Mahalaxmi Mining Compa. | Shahuwadi | 30/03/2001 | 29/09/2001 to 28/09/2021 | 20 |
| 12 | M/s Shivram minerals | Shahuwadi | 22/04/2002 | 21/04/2003 to 20/04/2033 | 30 |
| 13 | M/s Warna Minerals | Shahuwadi | 19/09/2002 | 11/08/2003 to 10/08/2033 | 30 |
| 14 | Chairman Sahyadri Dongri Vibhag | Shahuwadi | 20/01/2003 | 27/10/2003 to 26/10/2033 | 30 |
| 15 | Shri P.Z. Gawade, Samarth Niwas | Shahuwadi | 05/06/2004 | 29/01/2005 to 28/01/2035 | 30 |
| 16 | M/s Hindalco Industries Ltd. | Shahuwadi | 29/01/2008 | 05/05/2008 to 04/05/2038 | 30 |
| Raigad District | | | | | |
| 17 | M/s Vyagreshwar Minerals | Pen | 08/03/1978 | 13/12/1998 to 12/12/2018 | 20 |
| 18 | M/s Bhartesh Construction Com. | Shrivardhan | 06/03/2000 | 05/02/2002 to 04/02/2032 | 30 |
| 19 | M/s Bhartesh Construction Com. | Shrivardhan | 01/02/2001 | 05/02/2002 to 04/02/2032 | 30 |
| 20 | M/s Bhartesh Construction Com. | Shrivardhan | 01/02/2001 | 31/12/2002 to 31/12/2032 | 30 |
| 21 | M/s Altage Stone Crushing Indus. | Shrivardhan | 01/02/2001 | 31/12/2002 to 31/12/2032 | 30 |
| 22 | M/s Altage Stone Crushing Indu. | Shrivardhan | 01/02/2001 | 01/06/2009 to 30/05/2039 | 30 |
| 23 | M/s Bhartesh Construction Com. | Shrivardhan | 30/10/2002 | 07/04/2003 to 06/04/2033 | 30 |
| 24 | M/s Altage Stone Crushing Indus. | Shrivardhan | 16/08/2003 | 05/11/2003 to 04/11/2033 | 30 |
| 25 | Shri Manohar V. Daryanani, 3/4 | Shrivardhan | 29/12/2004 | 11/03/2008 to 10/03/2038 | 30 |
| Ratnagiri District | | | | | |
| 26 | Shri S.D. Dhanavate,"Shrayas" | Mandangad | 07/08/1968 | 29/11/89 to 28/11/2009 | 20 |
| 27 | M/s Veet Rag Homes Pvt. Ltd., | Rajapur | 25/09/2003 | 01/03/2004 to 28/02/2034 | 30 |
| 28 | M/s Ashapura MinechemLtd. | Dapoli | 21/12/2004 | 04/01/2005 to 03/01/2025 | 20 |
| 29 | M/s Chetan N. Shah, C/o Ashapura | Dapoli | 21/12/2004 | 04/01/2005 to 03/01/2035 | 30 |
| 30 | M/s Dinesh Trikhud, Saikripa | Dapoli | 02/03/2005 | 15/02/2005 to 14/02/2025 | 20 |
| 31 | M/s Ashapura MinechemLtd. | Dapoli | 02/03/2005 | 15/02/2005 to 14/02/2025 | 20 |
| 32 | M/s Infrastructure Logistics | Mandangad | 27/07/2010 | 27/08/2010 to 26/08/2030 | 20 |
| Sindhudurg District | | | | | |
| 33 | M/s Indian Aluminium Co., | Sawantwadi | 10/02/1968 | 23/5/1968 to 22/5/1998 | 30 |

Table 2a. Identified Mines and their Short Code

| S.N. | Name of Mine | Code |
|------|---|------|
| 1 | Minche Budruk Bhudargad Kolhapur | MBBK |
| 2 | Bhogoli-Pilani Chandgad Kolhapur | BPCK |
| 3 | Kanurkurd-Pundra-Dhamapur-Latgaon-Awandi-Ajra Chandgad Kolhapur | KACK |
| 4 | Kitvade Hajgoli Chandgad Kolhapur | KHCK |
| 5 | Durgamwadi-Padsali Radhanagari Kolhapur | DPRK |
| 6 | Karanje-Ramanwad-Patpanhali Radhanagari Kolhapur | KPRK |
| 7 | Burambal-Panundre-Ringewadi Shahuwadi Kolhapur | BRSK |
| 8 | Dhangarwadi Shahuwadi Kolhapur-1 | DSK1 |
| 9 | Dhangarwadi Shahuwadi Kolhapur-2 | DSK2 |
| 10 | Girgaon Shahuwadi Kolhapur | GSK |
| 11 | Manoli Shahuwadi Kolhapur | MSK |
| 12 | Niwale Shahuwadi Kolhapur | NSK |
| 13 | Pandharepani Shahuwadi Kolhapur | PSK |
| 14 | Udgiri Shahuwadi Kolhapur-1 | USK1 |
| 15 | Udgiri Shahuwadi Kolhapur-2 | USK2 |
| 16 | Yelwanjugai Shahuwadi Kolhapur | YSK |
| 17 | Mahalmirya Dongar Pen Raigad | MDPR |
| 18 | Bagmandala-Danda Shrivardhan Raigad | BDSR |
| 19 | Dandguri-Khujare Shrivardhan Raigad | DKSR |
| 20 | Deokhol Shrivardhan Raigad | DSR |
| 21 | Kudgaon-Harvit Shrivardhan Raigad | KHSR |
| 22 | Kurawade-Maral Shrivardhan Raigad | KMSR |
| 23 | Meghare Shrivardhan Raigad | MSR |
| 24 | Kavadoli Dapoli Ratnagiri | KDR |
| 25 | Rowale Dapoli Ratnagiri | RDR |
| 26 | Umbarshet Dapoli Ratnagiri | UDR |
| 27 | Gudheghar Mandangad Ratnagiri | GMR |
| 28 | Sakhari-Velas, Dighi Mandangad Ratnagiri | SDMR |

Table 2b. Bauxite Mines Operating in Maharashtra

| Sr. No. | Name of Mine | Latitude and Longitude |
|---------|--------------|------------------------------|
| 1 | MBBK | 16021°25.29"N, 74004°05.32"E |
| 2 | BPCK | 15055°20.97"N, 74007°40.96"E |
| 3 | KACK | 16000°56.49"N, 74005°36.78"E |
| 4 | KHCK | 15049°56.51"N, 74017°22.25"E |
| 5 | DPRK | 16026°53.65"N, 73056°23.67"E |
| 6 | KPRK | 16020°53.41"N, 73056°47.07"E |
| 7 | BRSK | 16050°15.38"N, 73054°04.67"E |
| 8 | DSK1 | 15055°47.57"N, 73050°11.01"E |
| 9 | DSK2 | 16055°27.86"N, 73050°05.45"E |
| 10 | GSK | 16050°52.39"N, 73052°31.67"E |
| 11 | MSK | 16057°06.82"N, 73047°49.38"E |
| 12 | NSK | 17006°15.97"N, 73049°32.84"E |
| 13 | PSK | 16054°07.18"N, 73049°06.15"E |
| 14 | USK1 | 17005°14.00"N, 73049°49.97"E |
| 15 | USK2 | 17005°33.67"N, 73049°54.35"E |
| 16 | YSK | 16054°24.57"N, 73050°33.29"E |
| 17 | MDPR | 18040°44.08"N, 73009°06.84"E |
| 18 | BDSR | 18000°58.99"N, 73003°00.56"E |
| 19 | DKSR | 18008°32.33"N, 73000°42.15"E |
| 20 | DSR | 18006°30.86"N, 73002°06.75"E |
| 21 | KHSR | 18013°11.47"N, 72058°46.97"E |
| 22 | KMSR | 18000°47.92"N, 73001°16.04"E |
| 23 | MSR | 18005°55.86"N, 73001°31.59"E |
| 24 | KDR | 17054°14.58"N, 73006°15.37"E |
| 25 | RDR | 17054°43.82"N, 73006°05.79"E |
| 26 | UDR | 17055°13.59"N, 73005°15.10"E |
| 27 | GMR | 17054°41.98"N, 73006°48.24"E |
| 28 | SDMR | 17056°30.34"N, 73003°10.03"E |

A large number of bauxite mines, 16 to be precise are located in the Kolhapur district and 12 mines are located in Konkan region that is in the districts of Raigad (7) and Ratnagiri (5). Tehsilwise distribution reveals that maximum number of mines are located in Shahuwadi tehsil (10) of Kolhapur district which is followed by the tehsils of Shrivardhan (6), Chandgad (3), Dapoli (3), Radhanagari (2), Mandangad (2), Bhudargad (1) and Pen (1). Mining affected area has been identified. Villages which fall within 2 km radius are the mining affected villages (Table 3). This information was obtained after carrying out buffer analysis in ArcGIS software.

Table 3. Villages within 2 Km Buffer Area of Mines

| Sr. No | Name of Mine | Villages within 2 km Buffer | Name of Villages |
|--------|--------------|-----------------------------|--|
| 1 | MBBK | 1 | Minche Bk. |
| 2 | BPCK | 1 | Nhaveli |
| 3 | KACK | 2 | Pundra, Suleran |
| 4 | KHCK | 2 | Kitvade, Dhamane |
| 5 | DPRK | 1 | Padasali |
| 6 | KPRK | 1 | Shelap |
| 7 | BRSK | 2 | Panundre, Burambal |
| 8 | DSK1 | 3 | Kasarde, Jawali, Gholasvade |
| 9 | DSK2 | 1 | Dhangarwadi |
| 10 | GSK | 2 | Mhalas Vade, Girgaon |
| 11 | MSK | 2 | Manoli, Masnoli |
| 12 | NSK | 1 | Ukhalu |
| 13 | PSK | 2 | Wadi Kalkavan, Dhangarwadi |
| 14 | USK1 | 1 | Udgiri |
| 15 | USK2 | 1 | Udgiri, Ukhalu |
| 16 | YSK | 2 | Dhangarwadi, Ainwadi |
| 17 | MDPR | 2 | Panchgani, Mahalmirya Dongar |
| 18 | BDSR | 2 | Saigaon, Kalinje |
| 19 | DKSR | 7 | Karle, Khujare, Madgarh Hill, Asuf, Borle, Dhandguri, Vakalghar |
| 20 | DSR | 6 | Devkhol, Shirvane, Dhangarmalai, Bapavali, Gulaghe, Mamvali |
| 21 | KHSR | 4 | Kudgaon, Harvit, Velas Agar, Velas |
| 22 | KMSR | 4 | Kuravade, Maral, Devaghar, Danda |
| 23 | MSR | 7 | Shirvane, Hunarveli, Chikhalap, Meghare, Bhardoli, Punir, Khargaon |
| 24 | KDR | 4 | Rawtoli, Kawadoli, Rowade, Ambavali |
| 25 | RDR | 3 | Rowade, Rawtoli, Kawadoli |
| 26 | UDR | 6 | Umbarshet, Kelashi, Kesi, Uthambar, Atgaon, Adhe |
| 27 | GMR | 5 | Umroli, Kudak Bk., Gudeghat, Gawalwadi, Panhali Bk. |
| 28 | SDMR | 2 | Ranavali, Sakhan |

The above referred information has been summarized and analyzed district and tehsilwise in Table 4. By observing the given data, in Kolhapur district Shahuwadi has 10 bauxite mines whereas it has been noticed that 15 villages fall within 2 km buffer zone having total area of 17192 hectares. Shrivardhan, one of the tehsils of Raigad, comes next to Shahuwadi. In this tehsil there are 6 bauxite mines but 30 villages with total area of 8859 hectares are affected by these mines. There is no bauxite mine in Ajra tehsil but two villages of this tehsil are affected by mines

located in Chandgad tehsil since these village are on the border of Ajra and Chandgad tehsil. These villages have 4726 hectares of land. Shahuwadi ranks first in the mining affected area and Shrivardhan, Ajra, Chandgad, Bhudargad, Dapoli, Mandangad, Pen and Radhanagari come next to Shahuwadi.

Table 4. Tehsil and District wise number of mines and their area

| Sr. No | Name of the Mine | Area in Hectors | Number of Mines |
|--------|------------------------|-----------------|-----------------|
| 1 | Shahuwadi (Kolhapur) | 17192 | 10 |
| 2 | Shrivardhan (Raigad) | 8859 | 6 |
| 3 | Pen (Raigad) | 2641 | 1 |
| 4 | Dapoli (Ratnagiri) | 2796 | 3 |
| 5 | Mandangad (Ratnagiri) | 2708 | 2 |
| 6 | Chandgad (Kolhapur) | 3891 | 3 |
| 7 | Bhudargad (Kolhapur) | 3257 | 1 |
| 8 | Ajra (Kolhapur) | 4726 | 0 |
| 9 | Radhanagari (Kolhapur) | 161 | 2 |
| | Total | 46232 | 28 |

In western Maharashtra, overall 28 mines have been found to be excavated (Table 5 & Figure 2).

Table 5. Mine wise Area of Excavated Landmass (in Square Meters)

| Sr. No | Name of Mine | Area of the Mine (in Sq. Meters) |
|--------|--------------|----------------------------------|
| 1 | MBBK | 276363 |
| 2 | BPCK | 580324 |
| 3 | KACK | 938476 |
| 4 | KHCK | 86687 |
| 5 | DPRK | 379212 |
| 6 | KPRK | 1724172 |
| 7 | BRSK | 267547 |
| 8 | DSK1 | 7994.5 |
| 9 | DSK2 | 103465 |
| 10 | GSK | 457219 |
| 11 | MSK | 42572 |
| 12 | NSK | 67976 |
| 13 | PSK | 39241 |
| 14 | USK1 | 200843 |
| 15 | USK2 | 206910 |
| 16 | YSK | 109373 |
| 17 | MDPR | 60315 |
| 18 | BDSR | 443606 |
| 19 | DKSR | 36227 |
| 20 | DSR | 26530 |
| 21 | KHSR | 47913 |
| 22 | KMSR | 33517 |
| 23 | MSR | 21894 |
| 24 | KDR | 374679 |
| 25 | RDR | 246135 |
| 26 | UDR | 262329 |
| 27 | GMR | 116223 |
| 28 | SDMR | 539334 |
| | Total | 76, 97,077 sq.mts. |

Shahuwadi is the first in the numbers of bauxite mines, as far as area is concerned Radhanagari is the first which is followed by Chandgad, Shahuwadi, Dapoli, Mandangad, Shrivardhan, Bhudargad and Pen respectively.

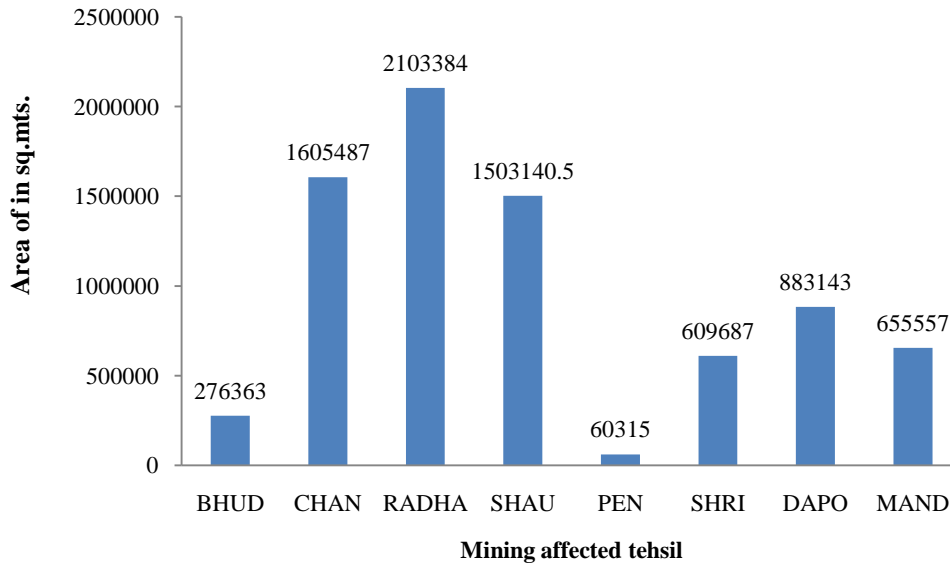


Figure 2. Tehsil wise total excavated Area of Mines

Table 6. Mine wise Depth of Excavated Landmass

| S. N. | Name of Mine | Depth of the Degraded Landmass in different Localities | | | | | | | | | | Average Depth |
|---------------|--------------|--|------|------|------|------|-----|-----|------|-----|-----|---------------|
| | | D1 | D2 | D3 | D4 | D5 | D6 | D7 | D8 | D9 | D10 | |
| 1 | MBBK | 6.9 | 7.1 | 6.8 | 7.2 | 8.1 | 7.2 | 6.9 | 6.8 | 6.8 | 6.3 | 7.0 |
| 2 | BPCK | 6.3 | 6.8 | 6.7 | 6.9 | 7.1 | 6.7 | 8.0 | 7.1 | 6.4 | 7.2 | 6.9 |
| 3 | KACK | 6.2 | 5.1 | 7.3 | 6.2 | 5.8 | 5.4 | 6.3 | 6.9 | 6.1 | 5.7 | 6.1 |
| 4 | KHCK | 4.1 | 4.0 | 4.2 | 5.1 | 3.3 | 4.1 | 3.3 | 2.9 | 3.9 | 5.6 | 4.1 |
| 5 | DPRK | 12.0 | 8.0 | 7.0 | 7.8 | 6.9 | 8.0 | 7.1 | 5.1 | 5.0 | 5.1 | 7.2 |
| 6 | KPRK | 3.9 | 4.1 | 3.9 | 3.8 | 4.1 | 4.2 | 4.1 | 4.0 | 4.9 | 3.1 | 4.0 |
| 7 | BRSK | 5.1 | 6.2 | 7.0 | 6.2 | 4.9 | 6.0 | 5.2 | 11.0 | 9.0 | 6.8 | 6.7 |
| 8 | DSK1 | 6.0 | 5.8 | 5.4 | 5.8 | 7.0 | 6.1 | 5.2 | 7.1 | 4.8 | 5.1 | 5.8 |
| 9 | DSK2 | 7.1 | 6.5 | 5.6 | 6.1 | 5.9 | 6.1 | 8.0 | 7.0 | 9.0 | 6.5 | 6.8 |
| 10 | GSK | 7.5 | 6.8 | 5.5 | 6.9 | 10.0 | 8.1 | 5.1 | 5.9 | 6.1 | 6.7 | 6.9 |
| 11 | MSK | 4.8 | 3.9 | 2.9 | 4.1 | 3.8 | 4.6 | 5.1 | 3.8 | 4.0 | 3.9 | 4.1 |
| 12 | NSK | 3.9 | 4.1 | 3.8 | 4.7 | 4.9 | 5.1 | 5.3 | 4.1 | 5.6 | 6.4 | 4.8 |
| 13 | PSK | 6.2 | 5.2 | 5.9 | 8.0 | 5.2 | 5.0 | 5.8 | 5.1 | 5.6 | 5.0 | 5.7 |
| 14 | USK1 | 8.0 | 10.0 | 9.8 | 11.2 | 8.0 | 7.6 | 8.9 | 8.4 | 8.0 | 9.0 | 8.9 |
| 15 | USK2 | 8.1 | 8.9 | 7.2 | 13.0 | 7.9 | 6.9 | 7.4 | 8.1 | 7.9 | 7.5 | 8.3 |
| 16 | YSK | 8.0 | 6.1 | 5.0 | 8.0 | 5.0 | 6.0 | 6.0 | 7.9 | 6.2 | 7.0 | 6.5 |
| 17 | MDPR | 4.9 | 5.2 | 5.9 | 6.0 | 4.8 | 4.5 | 4.6 | 5.0 | 5.0 | 5.2 | 5.1 |
| 18 | BDSR | 6.0 | 6.8 | 7.5 | 6.4 | 5.1 | 8.0 | 8.1 | 6.6 | 5.1 | 6.9 | 6.7 |
| 19 | DKSR | 5.0 | 4.2 | 4.8 | 5.1 | 6.0 | 5.1 | 6.0 | 4.3 | 4.1 | 5.0 | 5.0 |
| 20 | DSR | 4.1 | 5.2 | 6.9 | 4.1 | 5.1 | 4.2 | 4.0 | 6.0 | 5.8 | 5.0 | 5.0 |
| 21 | KHSR | 5.6 | 6.0 | 5.0 | 5.5 | 6.7 | 5.8 | 6.1 | 5.3 | 4.9 | 6.0 | 5.7 |
| 22 | KMSR | 6.5 | 7.0 | 5.1 | 7.0 | 8.0 | 7.5 | 9.0 | 6.0 | 6.1 | 7.1 | 6.9 |
| 23 | MSR | 4.4 | 4.5 | 4.1 | 4.8 | 4.0 | 3.9 | 4.3 | 4.7 | 3.4 | 4.3 | 4.2 |
| 24 | KDR | 5.8 | 6.2 | 6.9 | 6.2 | 6.9 | 6.8 | 5.8 | 6.5 | 6.1 | 6.4 | 6.4 |
| 25 | RDR | 6.1 | 6.9 | 6.7 | 5.9 | 5.8 | 6.8 | 6.0 | 5.9 | 5.1 | 6.1 | 6.1 |
| 26 | UDR | 5.9 | 6.0 | 6.1 | 6.2 | 6.1 | 5.9 | 5.1 | 7.0 | 5.8 | 5.9 | 6.0 |
| 27 | GMR | 5.8 | 4.1 | 5.2 | 5.9 | 5.1 | 5.8 | 5.2 | 6.9 | 6.1 | 5.0 | 5.5 |
| 28 | SDMR | 5.3 | 9.5 | 10.0 | 8.0 | 9.9 | 6.7 | 5.3 | 6.6 | 5.9 | 5.1 | 7.2 |
| Average Depth | | | | | | | | | | | | 6.06 |

The average depth of ten different places / locations from the bauxite mine is the average depth of mine. The depths of all these mines are found up to 4 to 9 meters.

Table 7. Mine wise Difference in Depth of Excavated Landmass (in Meters)

| Sr. No | Name of Mine | Average Depth during Field Visit (A) | Depth of Mine EIA & Inspection Report (B) | Depth Difference (A-B) | Depth Difference in % (A-B) |
|--------|--------------|--------------------------------------|---|------------------------|-----------------------------|
| 1 | MBBK | 7.0 | 6 | 1.0 | 17 |
| 2 | BPCK | 6.9 | 7 | -0.1 | -1 |
| 3 | KACK | 6.1 | 5 | 1.1 | 22 |
| 4 | KHCK | 4.1 | 8 | -4.0 | -49 |
| 5 | DPRK | 7.2 | 8.5 | -1.3 | -15 |
| 6 | KPRK | 4.0 | 4 | 0.0 | 0 |
| 7 | BRSK | 6.7 | 3 | 3.7 | 125 |
| 8 | DSK1 | 5.8 | 5 | 0.8 | 17 |
| 9 | DSK2 | 6.8 | 6 | 0.8 | 13 |
| 10 | GSK | 6.9 | 5 | 1.9 | 37 |
| 11 | MSK | 4.1 | 4 | 0.1 | 2 |
| 12 | NSK | 4.8 | 5 | -0.2 | -4 |
| 13 | PSK | 5.7 | 5 | 0.7 | 14 |
| 14 | USK1 | 8.9 | 8 | 0.9 | 11 |
| 15 | USK2 | 8.3 | 8 | 0.3 | 4 |
| 16 | YSK | 6.5 | 5 | 1.5 | 30 |
| 17 | MDPR | 5.1 | 5 | 0.1 | 2 |
| 18 | BDSR | 6.7 | 6 | 0.7 | 11 |
| 19 | DKSR | 5.0 | 6 | -1.0 | -17 |
| 20 | DSR | 5.0 | 5 | 0.0 | 1 |
| 21 | KHSR | 5.7 | 5 | 0.7 | 14 |
| 22 | KMSR | 6.9 | 5 | 1.9 | 39 |
| 23 | MSR | 4.2 | 4 | 0.2 | 6 |
| 24 | KDR | 6.4 | 6 | 0.4 | 6 |
| 25 | RDR | 6.1 | 6 | 0.1 | 2 |
| 26 | UDR | 6.0 | 6 | 0.0 | 0 |
| 27 | GMR | 5.5 | 7 | -1.5 | -21 |
| 28 | SDMR | 7.2 | 3 | 4.2 | 141 |
| | Average | 6.06 M | 5.59 M | 0.47 M | 8.4% |

Source: Field Visit & EIA Report.

The depth of excavated land gives a clear picture about the amount of land that is excavated (Table 6). The depth measured during the field visit was compared to the depth mentioned in Environmental Impact Assessment Report. The depth measured in field visit did not match with the depth mentioned in EIA. Table 7 throws light on the difference between two observed at all the mines. Environment Impact Assessment Report and Inspection Report is submitted before beginning of mining work in which the information about its depth is determined which indicates the depth required for bauxite excavation. While comparing such information by actual visits of study area, depths in the mines are found either more or less compared to the depth mentioned in Environment Impact Assessment Report and Inspection Report. Further details analysis reveals that out of 28 mines, in 20 mines the depth difference between field measurement and EIA is less than 20%. It means that in about more than 70% mines the depth difference is less than 20% which is acceptable considering the hostile nature of mine owners during the field visits. The depth information, which is given in Environment Impact Assessment Report and Inspection Report, is considered

for further analysis because it is considered authentic by other government agencies. Overall, it can also be said that the depth mentioned in EIA is followed by the miner and there is hardly any deviation from it.

Discussion up to this point was restricted to the location of bauxite mines, their areas and the depth of excavated landmass. An attempt is made to estimate the volume of landmass that is excavated from the mines. These estimates are computed by using information on area and depth and is presented in Table 8. Table 8 gives minewise information about volume of excavated landmass in cubic meters. In this way total volume of excavated landmass that is 4,10,29,443 cubic meter land has been excavated in Maharashtra in order to get bauxite.

Tehsil wise volume of excavated landmass has been given in the Figure 3. In Radhanagari Tehsil 1,01,19,990 cubic meter landmass has been excavated which is maximum and is followed by Chandgad (94,48,144 cubic meter), Shahuwadi (82,64,761 cubic meter), Dapoli (52,98,858 cubic meter), Shriwardhan (35,06,374 cubic meter), Mandangad (24,31,563 cubic meter) Bhudargad (16,58,178 cubic meter) and Pen (3,01,575 cubic meter).

Table 8. Mine Wise Volume of Excavated Landmass

| S.N. | Name of Mine | Area of the Mine in Sq. Mts. | Depth in Meters | Degraded Land Mass in Cubic Meter |
|------|--------------|------------------------------|-----------------|-----------------------------------|
| 1 | MBBK | 276363 | 6 | 1658178 |
| 2 | BPCK | 580324 | 7 | 4062268 |
| 3 | KACK | 938476 | 5 | 4692380 |
| 4 | KHCK | 86687 | 8 | 693496 |
| 5 | DPRK | 379212 | 8.5 | 3223302 |
| 6 | KPRK | 1724172 | 4 | 6896688 |
| 7 | BRSK | 267547 | 3 | 802641 |
| 8 | DSK1 | 7994.5 | 5 | 39973 |
| 9 | DSK2 | 103465 | 6 | 620790 |
| 10 | GSK | 457219 | 5 | 2286095 |
| 11 | MSK | 42572 | 4 | 170288 |
| 12 | NSK | 67976 | 5 | 339880 |
| 13 | PSK | 39241 | 5 | 196205 |
| 14 | USK1 | 200843 | 8 | 1606744 |
| 15 | USK2 | 206910 | 8 | 1655280 |
| 16 | YSK | 109373 | 5 | 546865 |
| 17 | MDPR | 60315 | 5 | 301575 |
| 18 | BDSR | 443606 | 6 | 2661636 |
| 19 | DKSR | 36227 | 6 | 217362 |
| 20 | DSR | 26530 | 5 | 132650 |
| 21 | KHSR | 47913 | 5 | 239565 |
| 22 | KMSR | 33517 | 5 | 167585 |
| 23 | MSR | 21894 | 4 | 87576 |
| 24 | KDR | 374679 | 6 | 2248074 |
| 25 | RDR | 246135 | 6 | 1476810 |
| 26 | UDR | 262329 | 6 | 1573974 |
| 27 | GMR | 116223 | 7 | 813561 |
| 28 | SDMR | 539334 | 3 | 1618002 |
| | Total | 76,97,077 | | 4,10,29,443 |

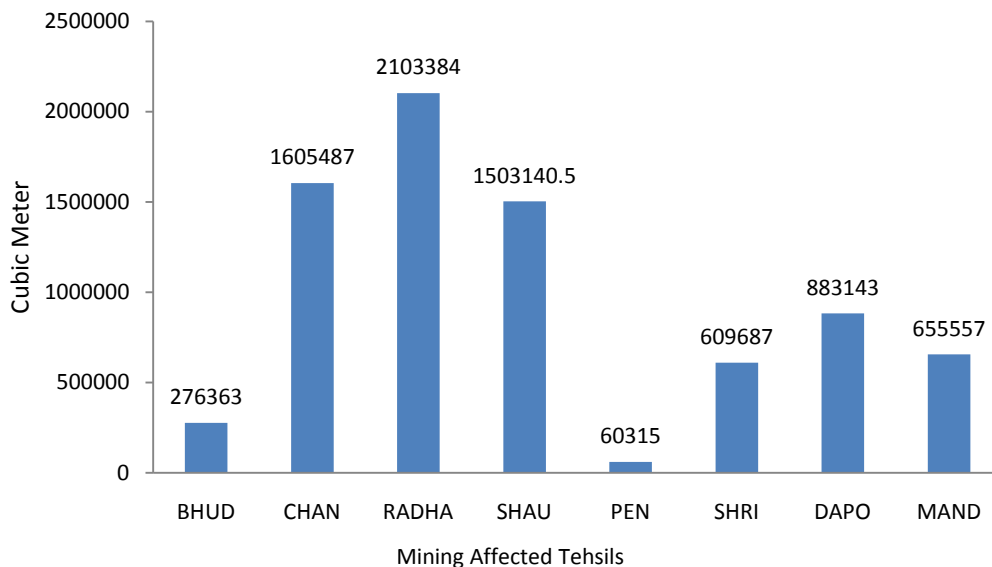


Figure 3. Tehsil wise volume of Excavated Landmass

We have estimated the volume of earth materials excavated from the mines of Western Maharashtra. Next step was to estimate weight of the earth material that is excavated. For this purpose, a six inch cube was created which was filled with mine material. This cube was then weighed. The weight of this cube turned out to be 5.520 kg. From this information it was then found that, for per cubic meter 1.559 tonne earth material has been excavated.

In order to find out the total mass of earth materials (per cubic meter) that have been excavated from the mines, a more scientific method that is bulk density of mine materials was also measured. Bulk density for mines of Konkan was found to be 1.670 tonne per cubic meter. Whereas bulk density of mines in the Sahyadri was 1.676 tonne per cubic meter. It is possible to find out / to calculate the excavated mass of earth materials through multiplying the bulk density of the mines of Konkan to

the volumes of each mines from the Konkan. Similarly, the excavated mass of earth materials can be calculated through multiplying the bulk density of the mines of

Sahyadri to the volumes of each mine from the Sahyadri. Up till 68,696,115.41 tones of earth materials have been excavated from the bauxite mines of the Western Maharashtra.

Table 9. Mine wise weight of excavated earth materials

| S. N. | Name of Mine | Degraded Land Mass in Cubic Meter | Mass of Earth Materials (Tons Per cubic Meter) | Mass of Earth Materials (tons Per cubic Meter) |
|-------|--------------|-----------------------------------|--|--|
| 1 | MBBK | 1658178 | 1.676 | 2779106.328 |
| 2 | BPCK | 4062268 | 1.676 | 6808361.168 |
| 3 | KACK | 4692380 | 1.676 | 7864428.88 |
| 4 | KHCK | 693496 | 1.676 | 1162299.296 |
| 5 | DPRK | 3223302 | 1.676 | 5402254.152 |
| 6 | KPRK | 6896688 | 1.676 | 11558849.09 |
| 7 | BRSK | 802641 | 1.676 | 1345226.316 |
| 8 | DSK1 | 39972.5 | 1.676 | 66993.91 |
| 9 | DSK2 | 620790 | 1.676 | 1040444.04 |
| 10 | GSK | 2286095 | 1.676 | 3831495.22 |
| 11 | MSK | 170288 | 1.676 | 285402.688 |
| 12 | NSK | 339880 | 1.676 | 569638.88 |
| 13 | PSK | 196205 | 1.676 | 328839.58 |
| 14 | USK1 | 1606744 | 1.676 | 2692902.944 |
| 15 | USK2 | 1655280 | 1.676 | 2774249.28 |
| 16 | YSK | 546865 | 1.676 | 916545.74 |
| 17 | MDPR | 301575 | 1.67 | 503630.25 |
| 18 | BDSR | 2661636 | 1.67 | 4444932.12 |
| 19 | DKSR | 217362 | 1.67 | 362994.54 |
| 20 | DSR | 132650 | 1.67 | 221525.5 |
| 21 | KHSR | 239565 | 1.67 | 400073.55 |
| 22 | KMSR | 167585 | 1.67 | 279866.95 |
| 23 | MSR | 87576 | 1.67 | 146251.92 |
| 24 | KDR | 2248074 | 1.67 | 3754283.58 |
| 25 | RDR | 1476810 | 1.67 | 2466272.7 |
| 26 | UDR | 1573974 | 1.67 | 2628536.58 |
| 27 | GMR | 813561 | 1.67 | 1358646.87 |
| 28 | SDMR | 1618002 | 1.67 | 2702063.34 |
| | Total | | | 68696115.41 |

The minewise excavated mass of earth materials of the mines of the Western Maharashtra has been calculated and presented in Table 9, whereas tehsil wise; weight of excavated earth materials has been given in Figure 4. The mass of earth materials that has been excavated from the mines is greater in the tehsils of Radhanagari, Chandgad, Shahuwadi.

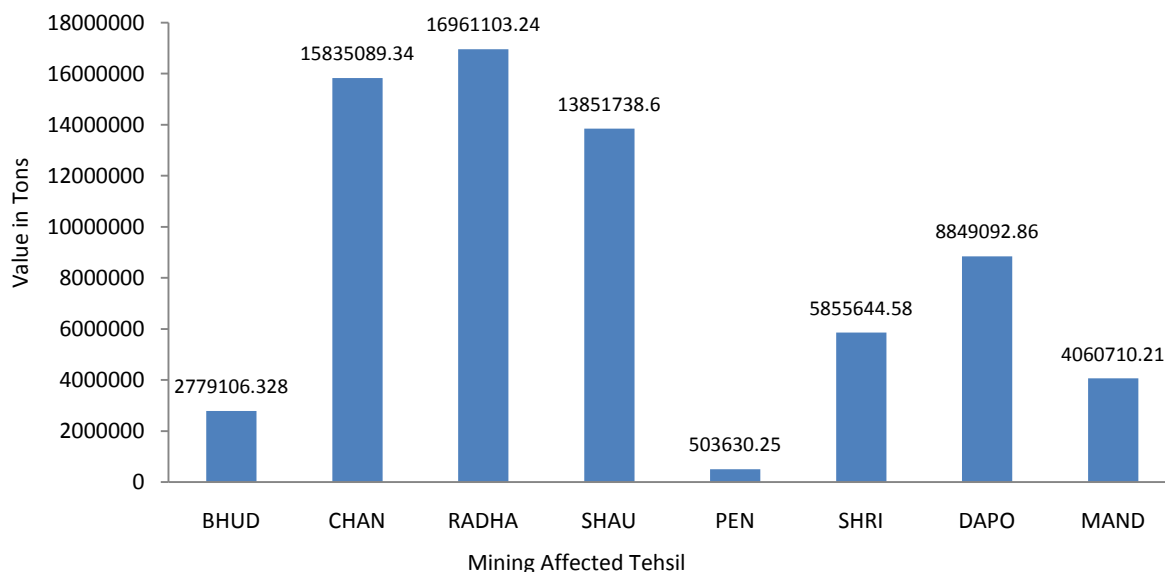


Figure 4. Tehsilwise Mass of Excavated Earth Materials (Tons)

In Western Maharashtra, tehsilwise and minewise volume of excavated earth materials from bauxite mines and weight of the materials has been estimated. An attempt is made to estimate minewise and tehsilwise weight of waste dump material and total bauxite production. Stripping ratio has been used for this analysis. Stripping ratio of bauxite mines of India is 1.281. It means out of total earth materials 54.55 % waste dump material is created. Such

waste materials are mounted / dumped near the mining areas. Table 10 gives minewise bauxite production, whereas Table 11 gives tehsilwise waste dump materials and bauxite production. The tables also give information about the total mass of excavated earth materials. Earth materials have been excavated in greater quantities through the mines of tehsils Radhanagari, Chandgad and Shahuwadi.

Table 10. Mine wise weight of excavated Earth Materials, Waste Dump Materials and Bauxite Production

| Sr. No. | Name of Mine | Mass of Earth Materials (Tons) | Waste Earth Materials in Tons | Bauxite Production in Tons |
|---------|--------------|--------------------------------|-------------------------------|----------------------------|
| 1 | MBBK | 2779106 | 1667464 | 1111643 |
| 2 | BPCK | 6808361 | 4085017 | 2723344 |
| 3 | KACK | 7864429 | 4718657 | 3145772 |
| 4 | KHCK | 1162299 | 697380 | 464920 |
| 5 | DPRK | 5402254 | 3241352 | 2160902 |
| 6 | KPRK | 11558849 | 6935309 | 4623540 |
| 7 | BRSK | 1345226 | 807136 | 538091 |
| 8 | DSK1 | 66994 | 40196 | 26798 |
| 9 | DSK2 | 1040444 | 624266 | 416178 |
| 10 | GSK | 3831495 | 2298897 | 1532598 |
| 11 | MSK | 285403 | 171242 | 114161 |
| 12 | NSK | 569639 | 341783 | 227856 |
| 13 | PSK | 328840 | 197304 | 131536 |
| 14 | USK1 | 2692903 | 1615742 | 1077161 |
| 15 | USK2 | 2774249 | 1664550 | 1109700 |
| 16 | YSK | 916546 | 549927 | 366618 |
| 17 | MDPR | 503630 | 302178 | 201452 |
| 18 | BDSR | 4444932 | 2666959 | 1777973 |
| 19 | DKSR | 362995 | 217797 | 145198 |
| 20 | DSR | 221526 | 132915 | 88610 |
| 21 | KHSR | 400074 | 240044 | 160029 |
| 22 | KMSR | 279867 | 167920 | 111947 |
| 23 | MSR | 146252 | 87751 | 58501 |
| 24 | KDR | 3754284 | 2252570 | 1501713 |
| 25 | RDR | 2466273 | 1479764 | 986509 |
| 26 | UDR | 2628537 | 1577122 | 1051415 |
| 27 | GMR | 1358647 | 815188 | 543459 |
| 28 | SDMR | 2702063 | 1621238 | 1080825 |
| | Total | 68696115 | 41217669 | 27478446 |

Table 11. Tehsil wise weight of excavated Earth Materials, Waste Dump Materials and Bauxite Production

| Tehsil | Degraded Earth Materials in Tons | Waste Earth Materials in Tons | Bauxite Production in Tons |
|--------|----------------------------------|-------------------------------|----------------------------|
| BHUD | 2779106 | 1667464 | 1111643 |
| CHAN | 15835089 | 9501054 | 6334036 |
| RADHA | 16961103 | 10176662 | 6784441 |
| SHAU | 13851739 | 8311043 | 5540695 |
| PEN | 503630 | 302178 | 201452 |
| SHRI | 5855645 | 3513387 | 2342258 |
| DAPO | 8849093 | 5309456 | 3539637 |
| MAND | 4060710 | 2436426 | 1624284 |
| Total | 68696115 | 41217669 | 27478446 |

Though we get the information of total bauxite production through Indian Year Book. The total bauxite production, tehsil and minewise, can be calculated with the help of stripping ratio. The tehsilwise information of total bauxite production has been given in Table 11 and Figure 5, whereas minewise information of total bauxite production is given in Table 10. A total of 27,478,446

tonne bauxite has been produced in Maharashtra.

It has been noted that forests are also affected due to bauxite excavation in the Western Maharashtra. The details of leased bauxite mines, forest and non-forest area of Maharashtra is given tehsil wise in Table 12. If observed keenly, one can easily understand its effects on forest and wild life which is disturbed due to deforestation (Figure 6).

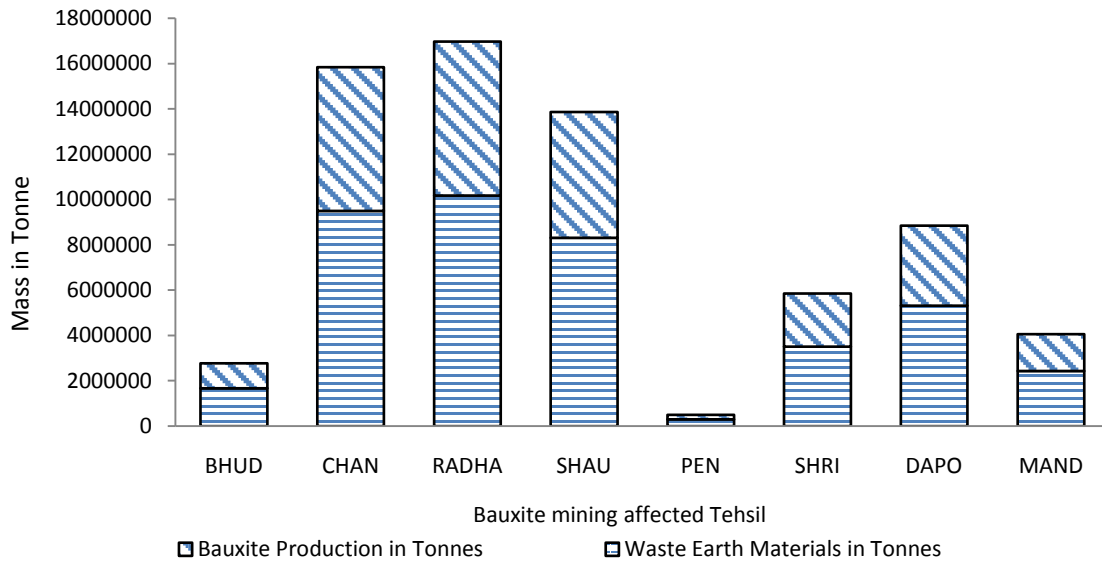


Figure 5. Tehsil wise Bauxite Production and Waste Generated Materials

Table 12. District and Tehsil wise Mine Leases, Forest and Non-Forest Area

| Sr. No. | District | Tehsils | Leases | Forest Area (In Hect.) | Non-Forest Area (In Hect.) | Total Area (In Hect.) |
|---------|------------|-------------|--------|------------------------|----------------------------|-----------------------|
| 1 | Ratnagiri | Mandangad | 3 | 0 | 358.09 | 358.09 |
| 2 | | Dapoli | 4 | 0 | 419.47 | 419.47 |
| 3 | Raigad | Pen | 1 | 0 | 79.98 | 79.98 |
| 4 | | Shriwardhan | 8 | 0 | 443.14 | 443.14 |
| 5 | Kolhapur | Radhanagri | 2 | 535.78 (71%) | 234.43 (29%) | 770.21 |
| 6 | | Chandgad | 3 | 41.94 (22%) | 149.66 (78%) | 191.6 |
| 7 | | Shahuwadi | 9 | 919.16 (38%) | 1504.48 (62%) | 2423.64 |
| 8 | | Bhudargad | 1 | 0 | 98 | 98 |
| 9 | Sindhudurg | Sawantwadi | 1 | 45 | 0 | 45 |
| 10 | Satara | Satara | 1 | 0 | 125.06 | 125.06 |
| Total | | | 33 | 1541.88 (31%) | 3412.31 (71%) | 4954.19 |

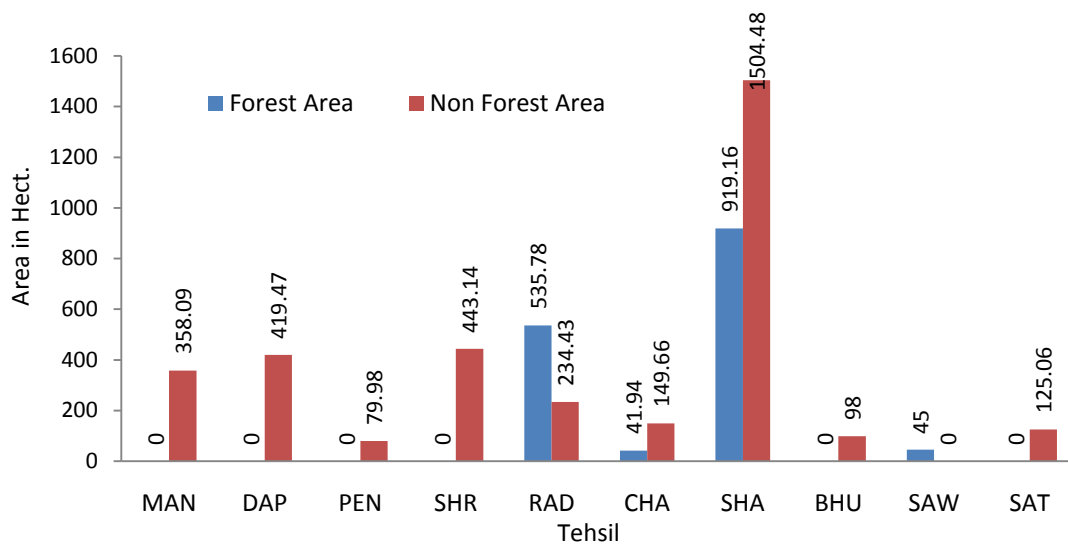


Figure 6. Tehsil wise Area of Mining Lease

In Radhanagari tehsil 770.21hector land has been sanctioned for two bauxite mines by the government. Out of this land, 535.78 hector means 71% land is under forest whereas only 234.43 hector means 29% land is non-forest. The government has sanctioned 191.6 hector land for

three bauxite mines in Chandgad tehsil. Out of the said area, 4.94 hector (22%) land is under forest while 149.66 hector, it means 78% land, is non-forest area. In Sahuwadi tehsil, 2423.64 hector land has been sanctioned for 9 bauxite mines. Out of this area, 919.16 hector (38%) land

is under forest whereas 1504.48 hector land means 62% land area is non-forest. It has been understood by observing above given information in a tabular form that the most of the land has been used for bauxite projects in Kolhapur district were under forest. In Kolhapur district, 1496.88 hector land out of 3483.45 hector sanctioned land for the purpose of bauxite excavation is under forest. In Western Maharashtra, the government has sanctioned 4784.13 hector land for bauxite mining projects. Out of this area, 1496.88 hector land, mean 31.29%, is under forest. With the help of above given information one can imagine the effects of mining on the forest. Mining activity has and will considerably affect forests in the region.

5. Conclusion

The government has leased 33 bauxite mining projects in Western Maharashtra. Prior to 1968, no mining project has been leased by the government. Shahuwadi (10), Shrivardhan (8), Dapoli (4), Mandangad (2), Chandgad (3), Radhanagari (2), Bhudargad (1), Pen (1), Sawantwadi (1) and Rajapur (1) mines have been leased for bauxite excavation. Government has leased above-mentioned 33 mines but actually in order to excavate bauxite minerals 28 leased mining places are observed. In Kolhapur district 16, 7 in Raigad and 5 bauxite mines in Ratnagiri districts are found. Tehsil-wise Shahuwadi (10), Chandgad (3), Radhanagari (2), Bhudargad (1), Shrivardhan (6), Dapoli (3), Mandangad (2) and Pen (1) have bauxite mines. The thickness of bauxite ranges from 0.3 m. to a maximum of 10.6 meters. Bauxite occurs between 1000 m – 1100 m above MSL in Kolhapur and Satara districts and at 150 m – 200 m above MSL in Ratnagiri and Kolaba districts.

Villages falling within 2 km radius from the bauxite mine are the mining affected villages. Twenty five villages in Sahyadri region of Kolhapur district and fifty two villages in Konkan region of Raigad and Ratnagiri districts are the mining affected villages. Total mining affected village area of Western Maharashtra is 46232 hectors means 462,320,000 Sq.Mtrs. In Western Maharashtra 7,697,076.5 Sq. Mtrs. of Land has been excavated for bauxite mining. Out of this in the Konkan region total 2,208,702 Sq. Mtrs. and Sahyadri 5,488,375 Sq. Mtrs. of land has been excavated. In Western Maharashtra average up to 5.7 meters depth of Land has been excavated for bauxite mining. In the Konkan region average up to 5.33 meters and Sahyadri 5.8 meters depth of land has been excavated. 41,029,443 m³ of land has been excavated in Western Maharashtra. Out of this in the Konkan region 11,538,370 m³ and Sahyadri 29,491,072.5 m³ of land has been excavated for last few decades.

Bulk density of mine land materials of Konkan region is 1670 kg/m³ and in Sahyadri it is 1676 kg/m³. It means 1.670 tonne/m³ in Konkan and 1.676 tonne/m³ in Sahyadri region. In Western Maharashtra 68,696,115.41 Tons of earth material has been excavated. Out of this in the region of Konkan 19,269,078 Tons and Sahyadri 49,427,037.5 Tons of earth material has been excavated. Out of total earth materials 41,217,669 tons of waste is generated because of bauxite mining in Western Maharashtra. From the mines of Konkan 11,561,446 tons and Sahyadri 29,656,222 Tons waste dump material has

been created because of bauxite mining. 27,478,446 tons of bauxite has been derived from 28 mines which have been operating in Western Maharashtra. Out of these 7,707,631 tons in from Konkan mines and 19,770,818 Tons from Sahyadri mines.

In Western Maharashtra, the government has sanctioned 4,784.13 hectors of land for bauxite mining projects. Out of this area 1,496.88 hector land, that is 31.29%, is under forest. With the help of this given information imagine the effects of mining on the forest. Forest fragmentation has occurred in bauxite mining affected areas of Western Maharashtra because villagers use wood as a fuel, people use edible items which we get from the forest, people are not aware of richness of biodiversity, there is deforestation for bauxite mines, less deforestation rather than bauxite mining purpose, there is loss of biodiversity, growth of trees affect due to dust accumulation on the leaves of trees, Plant growth made by mining companies does not find. Dust pollution is another important impact of bauxite mining affected areas of Western Maharashtra because of increase of dust in the air. Dust accumulates on the leaves of trees, dust accumulates on the houses and its surrounding, dust affects the lives of humans and animal. Sometimes bauxite companies do not cover bauxite during transportation, in order to reduce dust pollution; bauxite mining company does not sprinkle water regularly in mining area as well as roads.

Due to erosion of fertile soil land near mines is degrading. Soil layer is removed aside, rock surface is removed aside, and bauxite mining area cannot be reused for the development of villages. Degraded land by bauxite mining cannot be reused for the sustainable development of villages, surroundings of mine land has not planted trees properly in order to reduce soil erosion, generated overland flow does not get collected in mine land pit in rainy days, mining companies do not take enough efforts to reduce soil erosion. Because of bauxite mining activity local water resources have been impacted. Underground water level has decreased which causes lowering of water level of public sources like wells, hand-pump of bore wells. There are numerous first order streams which originate in bauxite mining affected area. First order streams have disappeared where mining activity has been done. Ground water level has decreased, turbidity has increased because of mixing of washed soil into streams which is deposited into nearby water bodies. Most of the overland flows at mining places have disappeared due to bauxite mining. Wild existence has reduced due to bauxite transportation and associated activities. Ecosystem balance is disturbed due to mining activity.

This paper was focused on impact of bauxite mining on physical environment. In general it can be inferred from the excavated land analysis and personal interviews with the locals that bauxite mining activity has dominated the changes observed in the physical environment.

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