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1 Empirical Study of Impact of Coal Mining in Jharia Coal Field: A Comparative Study of Tata Steel Limited and Bharat Coking Coal Limited

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Abstract:

Background: *This study scales the various impacts of the two premier coal companies viz: Tata Steel Limited and Bharat Coking Coal Limited, in land, air, water and flora and fauna in their respective buffer zones.*

Aim of the study: *The aim of this study is to compare the environmental impacts of coal mining in the buffer zones of two premiere coal enterprises namely Tata Steel Limited and Bharat Coking Coal Limited in the Jharia coal field. In this light the present study is being conducted to concentrate on the impacts of coal mining on land and livelihood, impacts of coal mining on air, water, flora and fauna.*

Methods and materials: *A total of 300 samples were selected on the basis of purposive sampling method, out of 300, 150 were from the three sample villages under the Tata Steel Limited viz Petia, Dukhitdi, and Rampur, another 150 samples were selected from the Amtal, Kuia and Parasbania (Balichirka) villages lying in the buffer zone of Bharat coking coal limited. Data is collected through structured schedule and interview. Descriptive statistical analysis is carried out to compare the similarities and differences of opinion under the sample villages.*

Area of Study: *Jharia coalfield situated in Dhanbad district of Jharkhand, having latitudes 23°38° N to 23° 52° N and longitudes 86°08°E to 86°29°E. Six sample villages were judiciously chosen which falls within the active coal mining buffer zone of Tata steel limited and Bharat coking coal limited in the Jharia coal field of Dhanbad district, Jharkhand. Out of the three sample villages under Tata steel limited, Dukhitdi and Rampur falls within the radius of 2 Km and the Petia village is within 5 Km radius from the active mining buffer zone. Out of the three sample villages under Bharat coking coal limited, Amtal, Kuia falls within the radius of 1 km and the Parasbania (Balichirka) village is within 4 Km radius from the active mining buffer zone.*

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Conclusion: *The study of responses and field observations clearly showed that the adverse effects on the environment (land, air, water, flora and fauna) of coal mining are more significant in the operational areas under Bharat Coking Coal Limited than that of the Tata Steel Limited, while levels of satisfaction of the respondents for mitigate these challenges is significantly higher within the sample villages under Tata Steel Limited.*

Keywords: *Environment, Mining and Livelihood*

Introduction

Coal mining has a pre calculated adverse affect on the environment like other mining and its redressed measures are also well documented by the mining agencies in their Environment Impact Assessment (EIA) and Environment Management Plan (EMP)s are legal obligations and certain check mechanism are also imposed to regulate them. Schedule VII under Companies Act, 20l3 also lays stresses on ensuring environmental sustainability, ecological balance, protection of flora and fauna, animal welfare, agro forestry, conservation of natural resources and maintaining quality of soil, air and water, which is adopted by BCCL in its declared CSR policy and TATA company too took the oath to protect environment by Plantation and afforestation activities; Encouraging alternative energy sources; Recharging soil water levels; Biodiversity conservation and research, awareness and activism on biodiversity issues, and awareness raising on environmental issues. Hence the present study took a plunge to verify the same in the sample villages under the buffer zone of BCCL and TATA. Table 1 illustrates the landholding pattern, agricultural land availability and respondents engage in agriculture practice.

Table 1

The landholding pattern, agricultural land availability and respondents engage in agriculture practice

Particulars	Responses	TATA		BCCL	
		Count	Column N %	Count	Column N %
Landholding	Less than 2 acare	42	28.0%	65	43.3%
	2 acare to 5 acare	102	68.0%	81	54.0%
	5 acare and above	6	4.0%	4	2.7%
Agricultural Land Availability	Not Available	5	3.3%	57	38.0%
	Available	145	96.7%	93	62.0%
Agriculture Practitioners	Not Available	53	36.6%	65	69.9%
	Available	92	63.4%	28	30.1%

(Source: Primary)

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Impact of coal mining on landholding and agricultural land availability

Coal mining requires large tracts of land for extraction processes, (Mishra, & Das. 2020) especially open caste mining process requires huge land (Sribas, 2015) results in loss of agricultural land due to large-scale mining (Doso Jnr et al. 2015) it was observed that percentage of households having agricultural land is lesser in coal mining area than that of those who were not affected by coal mining (Mishra, 2015). This is also evident in Table 1 because in both the groups the land holding and agricultural land availability is very low, although when we compare between the sample villages under Tata Steel Limited and Bharat Coking Coal Limited it was found that the landholding and agricultural land availability is less in the sample villages under Bharat Coking Coal Limited as compared to the sample villages under Tata Steel Limited. Majority of the respondents under the sample villages have 2 acre to 5 acre of land and the percentage of agricultural land availability is significantly very high in the sample villages under Tata Steel Limited than that of the sample villages under Bharat Coking Coal Limited. The main reason behind this is the type of mining activity taking place in the buffer zone of Bharat Coking Coal Limited. As in buffer zones of Bharat Coking Coal Limited both underground as well as opencast mining is available.

Impact of coal mining on agricultural practice

Several phases of the coal fuel cycle (extraction, reclamation, cleaning, combustion, and waste disposal) have the potential to affect the agricultural industry affect farmlands either directly or indirectly through subsidence (Bernad, 1979). This mining method causes land subsidence and it is hazardous to the soil (Haibin & Liu, 2010). It hampers the soil structure by changing its properties which later on causes many eco-environmental damages like soil erosion, topographical and hydrological changes, crop yields reduction, restriction in the growth of vegetation and loss of top soil as well as agricultural land (Meng et al, 2009; Yang et al, 2016; Shi et al., 2017; Wang et al., 2017). Large-scale mining can negatively impact on agricultural sector (Caselli, & Coleman II, 2001; Kitula, 2006; Hansen, & Prescott,2002; Brahmbhatt, Canuto, & Vostroknutova, E. 2010). The coal extraction work causes, agricultural land pollution (Rashid et al., 2014; Rashid, et al., 2014) acquization of cultivable land (Sribas, 2015) loss of productive layer of soil, (Zhengfu et al., 2010) resulted in lesser agricultural land in coal mining area(Mishra, 2015).The agricultural practices has been lost due to the non fertility of the soil (Guha, 2014)can affect food crop production (Doso Jnr et al. 2015)from the above studies it is clear that coal mining activities drastically affects the soil and crop production this affects the agricultural practices as a primary source of livelihood. Table 1 clearly reflects the impact of coal mining on agricultural practice as only 63.4percent

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of the respondents engage in agricultural activity under the buffer zone of Tata Steel Limited where as the situation is alarming in the sample villages under the buffer zone of Bharat Coking Coal Limited because only 30.1percent of the respondents under the buffer zone engage in agricultural activities.

Impact of coal mining on livelihood

Ellis (2000) defines livelihood as that which comprises "…the assets (natural, physical, human, social and financial capital), the activities, and the access to these that together determine the living gained by the individual or household". Local economy is adversely affected by the coal mining as coal mining put a threat to the sustainability of local livelihood systems. In pre-mining period agriculture and forest resources served as the major source of income but in post mining period the source of incomes became mining centric (Mishra, 2019). Coal Mining is a good revenue generating source for government and it also highlight the resourcefulness of the country. But the negative impacts in loss in agricultural production which affect the communities are not being taken into account (Mishra, 2009). As agriculture is the main source of livelihood whereas land is acquired for mining resulted in less agricultural production (Mishra, 2009). Numerous studies (MITRE Corp., 1977; Kash et al., 1977; Murray, 1978) have already questioned the effects of coal mining on agriculture and giving it less attention in comparison to the increased coal production. The available vast literature related to this topic (Caudill, 1973; Doylc, 1976; Ostel~dorf and Gibson, 1976; Toolan, 1978) may be containing at best a modicum of factual information which is categorized as emotionally biased. Coal mining has direct impact over agriculture (Sribas, 2015). Several phases of the coal fuel cycle (extraction, reclamation, cleaning, combustion, and waste disposal) have the potential to affect the agricultural industry. Surface mining may affect farmland either directly through removal of the land immediately above the coal or indirectly through disturbance of' land for storage and loading areas, haulage and access roads, and final-cut reservoirs. Underground mining may affect farmlands either directly through installation of surface support facilities, including haulage roads and waste disposal sites, or indirectly through subsidence (Bernad, 979). The mining process polluted the environments especially surrounding soil and agricultural lands in many ways (Rashid, et al., 2014). The environmental adverse impact of coal mining including soil and agricultural land pollution is caused by poor monitoring system (Rashid, et al., 2014). Due to long coal pit mining the total natural environment has been degraded including the soil, the agricultural practices has been lost due to the non fertility of the soil and very low precipitation (Guha, 2014). Soil pollution is caused by hazardous mining waste like coal sludge, drainage, gangue and coal-bed methane

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(CBM) (Haibin & Liu. 2010). Large-scale mining can negatively impact on other sectors such as agriculture (Caselli, & Coleman II, 2001; Kitula, 2006; Hansen, & Prescott, 2002; Brahmbhatt, Canuto, & Vostroknutova, 2010).

Table 2
Issues of solid waste, livelihood and wasteland development

Particulars	Responses	TATA		BCCL	
		Count	Column N %	Count	Colum n N %
Dumps Solid Waste near Settlements	Never	139	92.7%	14	9.3%
	Rarely	11	7.3%	23	15.3%
	Often	0	0.0%	34	22.7%
	Always	0	0.0%	79	52.7%
Dumps Solid Waste near Farm Land	Never	144	96.0%	14	9.3%
	Rarely	4	2.7%	22	14.7%
	Often	2	1.3%	26	17.3%
	Always	0	0.0%	88	58.7%
Mining Activities Adversely Affected the Productive Capacity of the Lands	Not at all	89	59.3%	0	0.0%
	Slightly	8	5.3%	13	8.7%
	Moderately	6	4.0%	27	18.0%
	Extremely	47	31.3%	110	73.3%
Agricultural Landholders View: Mining Activities Adversely Affected the Productive Capacity of the Lands	Not at all	89	61.4%	0	0.0%
	Slightly	8	5.5%	9	9.7%
	Moderately	3	2.1%	21	22.6%
	Extremely	45	31.0%	63	67.7%
Agricultural practitioners view: Mining Activities Adversely Affected the Productive Capacity of the Lands	Not at all	81	88.0%	0	0.0%
	Slightly	8	8.7%	1	3.6%
	Moderately	3	3.3%	1	3.6%
	Extremely	0	0.0%	26	92.9%
Mining Activities Adversely Affecting the Livelihood Opportunities	Not at all	68	45.3%	0	0.0%
	Slightly	19	12.7%	7	4.7%
	Moderately	4	2.7%	12	8.0%
	Extremely	59	39.3%	131	87.3%
Agricultural land holders view: Mining Activities Adversely Affecting the Livelihood Opportunities	Not at all	68	46.9%	0	0.0%
	Slightly	19	13.1%	3	3.2%
	Moderately	4	2.8%	6	6.5%
	Extremely	54	37.2%	84	90.3%
Agricultural practitioners view: Mining Activities Adversely Affecting the Livelihood Opportunities	Not at all	60	65.2%	0	0.0%
	Slightly	19	20.7%	3	10.7%
	Moderately	4	4.3%	2	7.1%
	Extremely	9	9.8%	23	82.1%
Wasteland Development and	Not at all	141	94.0%	150	100.0

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Reclamation of Land Improve the Livelihood Opportunities					%
	Slightly	7	4.7%	0	0.0%
	Moderately	0	0.0%	0	0.0%
	Extremely	2	1.3%	0	0.0%
Satisfaction Level with Waste land Development Measures	Strongly dissatisfied	131	87.3%	142	94.7%
	Dissatisfied	10	6.7%	8	5.3%
	Satisfied	2	1.3%	0	0.0%
	Strongly Satisfied	7	4.7%	0	0.0%

(Source: Primary)

From the above mentioned studies it may be concluded that the primary sector (e.g. agriculture) is directly or indirectly drastically affected by the coal mining which accounts for diminishing the livelihood opportunities depends on agriculture.

The wide range of metalliferous and non-metalliferous minerals excavation from opencast and deep shaft methods through the process of dressing involving many physical and chemical processes originates high-volume material known as the mining waste (Twardowska, et al., 2004). In this light to study the varied impact of mining solid waste on the lives of local residents 300 responses were collected and analyzed the summary of the following shows that Tata steel limited is rarely engaged in the dumping of waste and the percentage for never dumping of waste near human settlement is as high as 92.7 percent. Although following the mixed techniques the majority i.e. 52.7 percent of the respondents from the sample villages under BCCL opined that Bharat Coking Coal Limited always dumping waste near human settlement, with often scoring 22.7 percent, while rarely is about 15.3 percent and the least never is 9.3 percent. Table 2 also clearly depicts the responses of the stakeholder's positive for that of Tata steel limited as 96.0 percent of the responses are "never" for dumping of overburden residue near the farmland, while it is approximately 2.7 percent from the sample villages under TATA for often and only 1.3 percent respondents opined for dumping of solid waste dumps rarely near arable land. As BCCL is practising both mining operations, and hence producing huge volume of non productive mine waste and seems to be in practice of often to always dumping of solid waste of mine overburden near the vicinity of arable land which is not only affecting the precious agricultural land, but it is a massive threat to ecological restoration along with pushing back the overall sustainable socio-economic scenario in the region. 58.7 percent of the respondents from the sample villages under BCCL opined that solid waste generated during the mining process is always dumped near the farmland while 17.3 percent of them opined for often

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followed by 14.7 percent rarely and only 9.3 percent opined for never dumping of solid waste near farmland.

Table 2 illustrates that mining activities adversely affected the productive capacity of the lands, in the response the respondents from the sample villages under Tata steel limited, which engages in only underground coal mining operations in the area. The respondents strongly believed that there is not at all degradation of productive capacity of the arable lands, and for this the responses recorded is about 59.3 percent for "not at all" and 5.3 percent respondents due to varied factors opine for degradation productive capacity of land, although for moderately it was less 3.3 percent and 31.3 percent of the respondents opine that overburden dumps degraded the productive capacity of the lands but they also suggest that there are several other factors responsible for this, which were associated in OB dumps. BCCL following mixed techniques of mining and predominantly laying it stresses on opencast mining is rapidly producing huge volume of OB dumps and dumping these waste materials in a very unscientific manner near the settlement and vicinity to arable lands, which is evident from the responses illustrated in Table 2 which clearly indicates up to 73.3 percent of the respondents feels that these OB dumps are extremely affecting the production capacity of the arable lands, due to varied associated factors. About 18.0 percent of the respondents are in the opinion that these activities of BCCL are accounting moderately for less productive capacity, whereas only 8.7 percent respondents feel that it is slightly affected the productive capacity, while null opined that mining operations carried out by BCCL does not affect the productive capacity of the lands. It is also evident from Table 2 that majority of the respondents having agricultural landholding and agricultural practicing under the sample villages under BCCL opined that mining operations carried out by BCCL extremely affected the productive capacity of the land. About 92.9 percent respondents engaged in agriculture believed that mining activities carried out by BCCL extremely affected the productive capacity of land although under the sample villages under TATA no respondents claim that the TATA's mining activities extremely affected the productive capacity of land however 8.3 percent respondents believed that TATA's mining slightly affected the productive capacity of land.

As evident from Table 2 the responses from the sample villages under TATA and BCCL for assessing the impact of coal mining on livelihood opportunities, the respondents from the sample villages under TATA where majority i.e. 45.3 percent of the respondents opined that mining activities carried out by TATA doesn't affect their livelihood, although 39.3 percent of the respondents opined that the ongoing mining

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activities of TATA adversely affected their livelihood followed by 12.7 percent slightly and 2.7 percent moderately affected. Although under the sample villages within BCCL a higher percentage of about 87.3 percent opined that the ongoing mining practices extremely affected their livelihood opportunities, while 8.0 percent of the respondents opined that their livelihood opportunities are moderately affected and only 4.67 percent reported for slightly affected. Amongst the agricultural landholders of sample villages under BCCL 92.1 percent of the respondents believed that their livelihood opportunities were extremely affected by the mining activities carried out by BCCL although only 37.2 percent of the respondents under the sample villages under TATA opined for same. Similarly those who practice agriculture in the buffer zones of BCCL there are 82.1 percent of the respondents believed that their livelihood opportunities were extremely affected by the mining activities carried out by BCCL whereas only 9.8 percent of the respondents under the sample villages under TATA opined that their livelihood opportunities were extremely affected. The differences in the opinion of the respondents from the sample villages under TATA and BCCL may be due to the nature of mining activities carried out by the respective coal companies, for example, BCCL practices both the type of mining underground and opencast mining in their respective leasehold areas and TATA is mainly operating underground mining practices, each type of mining has its own prons and cons although whatever the nature of mining activities carried out, it has severe impacts upon the environment(Land, water, and air) which to a greater extent affect the agricultural productivity and results in limited opportunities in the agricultural sector which eventually affect the livelihood.

In Table 2 it is evident that in the sample villages under TATA 1.3 percent respondents opined that wasteland development and reclamation of land extremely improve their livelihood opportunities, while 4.7 percent of the respondents opined for slightly improve of their livelihood opportunities. Although majority of the respondents i.e 94.0 percent reported that that wasteland development and reclamation activities of land doesn't improve any livelihood opportunities for them. On the other hand under the sample villages under BCCL none of the respondents opined for improving livelihood opportunities from initiatives undertaken for waste land development and reclamation of land, 100.0 percent of the agricultural landholders opined that the wasteland development and reclamation of land by BCCL not at all improve their livelihood opportunities. The responses under the sample villages under BCCL is shocking and alarming that the initiatives undertaken as a part of corrective measures for wasteland development is too far from reclamation of arable land, and thus their initiatives only seem to fulfil their

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legal obligation to environmental factors associated with mining laws. It is least focused to promote sustainable development through preserving the topsoil from erosion, restoring the soil nutrients or by imparting foreign fertile soil to make land arable in these regions to ensure a livelihood support for the agricultural community. The subsidiary of Coal India Limited (BCCL) has an ample scope to indulge through their CSR intervention for wasteland development and reclamation of arable land in such a manner to ensure sustainable development in the agricultural practices and promising a better scope of livelihood for the agricultural community. These actions will definitely leave a mark of sustainable development beyond the agricultural community as these are very much closely interrelated factors. As those of non-agricultural community could be trained and promoted for vermin-compost fertilizer production and other marketing skills which along with restoration of soil nutrients, certainly will provide livelihood opportunities in the community. If we talk about the level of satisfaction for the Waste land Development Measures then it is evident from Table 2 that majority of the respondents from the samples villages under TATA and BCCL were strongly dissatisfied with the measures undertaken for the above mentioned cause.

Impact of coal mining on air pollution

Across the globe, mining activities have either direct or indirect association with air pollution (Roy & Singh, 2014). In initial phase the quality of surface water in mining regions got contaminated due to the release of ash, oil, phosphorus, ammonia, urea, and acids like obnoxious substances (Reza & Singh 2010). The central impact of mining is long term and devastating as it shades negative impacts on local air (OECD. 2002). The activities such as drilling, blasting, and transportation, storage, disposal, loading and unloading, etc are the central cause behind air pollution (TERI, 2013; Higginbotham, Freeman, Connor, & Albrecht. 2010). And there is also coal dust that once produced contributes to particulate matter in the air which ultimately causes air pollution (Mishra & Das. 2017). However, the opencast mines create more air pollution problems with respect to dust than underground mining cause air pollution in the work zone and surrounding locations (Ghose & Majee. 2007 & Ghose, & Majee, 2000). The open casts are the major producer of fugitive dust to the air which ultimately pollutes the air environment (Katoria, Sehgal & Kumar. 2013). Mining waste including coal gangue, coal sludge, fly-ash, coal mine drainage and coal-bed methane (CBM) that are hazardous to the air (Haibin & Liu. 2010). The exposure to dusts like coal dust, crystalline silica for longer and regular period of time would be the reson behind lung diseases (CSPL,

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2016). The development of green belts around the highly air polluted area is recommended as source mitigative measures for the effective control of air pollution (Chaulya, 2004).

Table: 3
Impact of air pollution and level of satisfaction with the initiatives

Particulars	Responses	TATA Count	TATA Column N %	BCCL Count	BCCL Column N %
The Habitat is Grimy for Airborne Coal Dust	Never	0	0.0%	0	0.0%
	Rarely	31	20.7%	12	8.0%
	Often	27	18.0%	31	20.7%
	Always	92	61.3%	107	71.3%
Measures to Arrest Coal Dust	Never	32	21.3%	20	13.3%
	Rarely	118	78.7%	130	86.7%
	Often	0	0.0%	0	0.0%
	Always	0	0.0%	0	0.0%
Water Sprinkling by Mobile Water Sprinklers	Never	29	19.3%	41	27.3%
	Rarely	64	42.7%	80	53.3%
	Often	41	27.3%	25	16.7%
	Always	16	10.7%	4	2.7%
Level of Satisfaction in Respect to Dust Suppression Initiatives	Strongly dissatisfied	83	55.3%	121	80.7%
	Dissatisfied	51	34.0%	23	15.3%
	Satisfied	16	10.7%	6	4.0%

(Source: Primary)

The outcome of the responses is illustrated in Table 3 in response to the query of whether they face problems of dust and grimy habitats, the responses as illustrated in Table 3 are quite expected but unfortunate since more than 71.3 percent of the respondents of sample villages under BCCL and 61.3 percent of the respondents from the sample villages under TATA replied that their house, buildings, courtyards are always soiled with dirt borne out of coal dust. It is an often phenomenon for 18.0 percent of the respondents from sample villages under TATA and 20.7 percent for the respondents from the sample villages under BCCL. Only a fewer respondents opined that the grimy habitats for rarely about 8.0 percent of the respondents from the sample villages under BCCL, while 20.7 percent of respondents from the sample villages under TATA also added to the information that the doors and windows, if not closed always they are to covered with proper net messed and curtains the household articles and food are

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needed to covered, brooming or even moping twice a day, gets essential in dry windy days. This eventually scoops outs the time of female members of the households playing a key role in keeping the house clean and dirt free. Though this has a great relationship with weather conditions dirty free wet monsoon seasons but acute in dry summer and windy weather condition.

Coal dust is one of the major environmental hazardous substances associated with large coal-mining industries. The environmental impact of coal dust is most evident in the coal- mining area on daily basis while its impact on neighbourhood communities depends upon the wind conditions. Therefore it became necessary for mining industries to put effective mitigative measures to control the coal dust environmental impact. It is crucial to mention that air pollution constitutes health and safety hazards for mine workers and nearby residents also. Various health-related problems are associated with these coal dusts, the children and aged are prone to respiratory disorders, cough, allergy is also very common amongst the inhabitants of the region. Though the underground mining operations release comparatively very less dust to that of open cast mining methods in the air directly, but eventually in the overall process of storing of coal in dumps and transportation without proper management make the problem equally severe in the regions of both underground and open cast mining avenues. Hence, the researcher felt the need to answer of the quest that, are these companies doing enough scientific management to repress coal dust propagation during stocking and transportation. The responses are illustrated in Table 3. The observation of respondents regarding mode of transportation of coal from the mine sites as illustrated in Table 3 also wipes out the dust on policy implementation initiatives, as it is clear from the responses reflected in Table 3 is rarely for about 21.3 percent for the respondents from the sample villages under TATA and 13.3 percent of the respondents of sample villages under BCCL, opined that the coal is not being transported in covered vehicles, as it should have been in practice, on a contrary the Table 3 reveals that it uncovered vehicle transporting coal, about 78.7 percent responses from the sample villages under TATA and 86.7 percent respondents observation from the sample villages under BCCL, for coal transportation is not being done by covering trucks by tarpaulin as measures to arrest coal dust. The irresponsible acts are even adding to the magnitude problems of air pollution and putting the health and quality of life at risk of the stakeholders.

As evident from Table 3 only 10.8 percent respondents under the sample villages under TATA and it is merely 2.7 percent under the sample villages from BCCL respondents reported for "always" mobile water

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sprinkling system used to suppress the coal dust by the company specially for the road used for transportation of coal. It is much a rarely and often phenomenon undertaken by these coal companies. For rarely as illustrated in Table 3 under the sample villages of TATA accounts for 42.7 percent and under the sample villages under BCCL, it was 53.3 percent. Both the companies have enough scope for up gradation of their existing initiatives undertaken for arrest the dust by increasing the frequency of sprinkling of water through mobile sprinkles. The companies may also increase the radius of sprinkling especially in summer and the roads used for coal transportation.

Table 3 illustrates the opinion regarding the level of satisfaction for the initiatives undertaken by TATA and BCCL for dust suppression. Water quality in surrounding area affected due to the unclean run-off discharge of airborne dust originating from terminal machinery.

For example, The flora and fauna harmed by coal dust which in turn reduces the available oxygen amount for sea creatures like crab larvae, barnacles, mussels and clams and also impacting their fertility and growth. Unfortunately, there has been very little research into the effects of coal and coal dust on waterways and the ecosystems they support, mainly owing to the lack of adequate investigation.

As depicted in Table 3 in response to the query that up to what extent they are satisfied with initiatives undertaken by the companies, only 10.7 percent of the respondents from the respondents under the sample villages under TATA seems to be satisfied with the initiatives undertaken by the Tata steel limited but the respondents under the sample villages under BCCL it is merely 4.0 percent respondents feel satisfied with the initiatives undertaken by BCCL, while 34.0 percent dissatisfied with the initiatives undertaken by TATA for dust suppression and 15.8 percent respondents were dissatisfied under the sample villages from BCCL.

It is of imperative to note that about 80.7 percent of the respondents under the sample villages under BCCL are strongly dissatisfied with the operational measures and initiatives were undertaken by the BCCL to reduce air pollution by suppression of coal dust.

Although the data for strongly dissatisfied from the respondents under the sample villages under TATA also reveals in the higher side with 55.3 percent of the respondents do feel strongly dissatisfied with the initiatives were undertaken by Tata steel limited to check the air pollution in the area.

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Impact of coal mining on water pollution

The coal mining industry makes a country resource – rich and it is a good source of revenue for government. But the negative impacts in the form of water pollution (Mishra, 2009 & Gawor, 2014). The mining process polluted the environments especially surrounding water in many ways (Harun, Hossain, Urbi & Islam. 2014). For example aquatic life in rivers has been affected due to the discharge of mines drainage into various streams (Mishra & Das. 2020).

In long run the impact of coal mining on water quality is devastating as it also decreases the rain fall (OECD. 2002). Coal mining has not only disturbed the water quality and interference with groundwater quantity (Szczepanska, 1999) in the villages but also resulted in water scarcity (Mishra & Das. 2020). Availability of water against the huge demand of water in mining activities is always questioned (Mishra & Das. 2020). The coal extraction work causes, loss of underground water table (Zhengfu B, Inyang HI, Daniels JL, Frank O, Sue S (2010).

Groundwater level can face an extensive decrease due to underground mining activities (Wang, et al., 2017). This mining method destroys hydrologic conditions (Meng et al, 2009; Yang et al, 2016; Shi et al., 2017; Wang et al., 2017). Surface water and groundwater is becoming polluted due to coal mining activity.

According to Reza & Singh (2010) in the initial phase, the release of obnoxious substances such as ash, oil, phosphorus, ammonia, urea, and acids are contaminating the surface water quality of the mining regions. With coal mining the country is becoming resource-rich and the government is earning good revenue but the in cost of pessimistic impacts in the form of water pollution, (Mishra, 2009). The dry spring, withering of vegetation can be caused by decreasing groundwater level.

Especially in the arid region where underground aquatic environment is fairly vulnerable, groundwater table decline can lead to land collapse once it is blow the warned level (Leia, et al., 2009). Lack of monitoring of impact of coal mine on the surrounding environment is one of the cause environmental problems including water pollution (Harun, et al., 2014).

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Table 4

Impact on water bodies and level of satisfaction with the initiatives

Particulars	Responses	TATA		BCCL	
		Count	Column N %	Count	Column N %
Coal Mining Affects the Quality of Water Bodies	Extremely	83	55.3%	110	73.3%
	Moderately	38	25.3%	21	14.0%
	Slightly	29	19.3%	19	12.7%
Dewatering of Ground Water as a Part of Mining Activity Develops a Declining Trend in Water Table	Extremely	112	74.7%	106	70.7%
	Moderately	26	17.3%	29	19.3%
	Slightly	12	8.0%	15	10.0%
Level of Satisfaction with the initiatives to mitigate water scarcity	Strongly dissatisfied	25	16.0%	121	80.7%
	Dissatisfied	17	11.3%	23	15.3%
	Satisfied	45	30.3%	6	4.0%
	Strongly satisfied	63	42.0%	0	0.0%

(Source: Primary)

The Table 4 shows that more than 50 percent respondents from both the groups expressed their opinion in holding up the mining activities as an extreme factor for water pollution in the region's water bodies starting from the small jores (streams) nala, ponds to even the river (Damodar and katki) drainage system in the area. The respondents speak out the water is turbid and in most cases not fit for use of various daily domestic needs' viz. Washing clothes, bathing etc also not suitable for the irrigational purpose at large. Even the fresh rain water getting in the environment, gets polluted, dust pesticides and the building roof, plants and open spaces, roads and other uncovered solid wastes dumps especially overburden get along with the rainwater with other automobile lubricants of vehicles used for coal mine operational area, non soluble materials used for mining activities and for transportation requirements get away as wash off and run off to the surroundings water bodies and agricultural lands. In contrary to the reduction of pollution the rains even adds more to water pollution in these coalfield areas which is a matter of grave concern as it is adversely affecting the aquatic ecosystems to a large extent and it is also evident that majority of the respondents from the sample villages under TATA and BCCL were extremely dissatisfied with the initiatives to mitigate water scarcity although when we compare the level of dissatisfaction it seems more within the sample villages under BCCL. Hence, the management of the companies should devise the mechanism to check this issue beyond fulfilling administrative obligations, so that the products of mining

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could be restricted to reach the surface water bodies and drainage system. The development focused on by mining of natural fuel resources should not be set free on the cost of destruction of prime natural resource” like “water resources” because it is the key life sustaining factor for “human being”.

The response has to follow the trend with increase of distance from the spot of mining activity the acuteness of the problem decrease, the respondents in close vicinity opted for a extremely option for water level declining trend developed within a decade with 74.7 percent from the respondents under the sample villages under TATA and 70.7 percent from the sample villages under BCCL opining that the water level in wells, tube wells for domestic have declined to such a level that wells are not any use in the summer and since the surface water bodies also get dried up, it is more than desert condition in the areas in the close vicinity of mine, operated by Bharat coking coal limited as it does not provide ample quantity of supply water as the initiatives of Tata steel limited are quite focused to provide treated supply water to the community also along with its employees.

Moving away from close vicinity in the surrounding community with a radius of 2-3 Km the problem of water level declination scores percentage of responses also decreases too moderately with a score of 17.3 percent from the respondents of sample villages under TATA and 19.3 percent from the respondents of sample villages under BCCL and for slightly in this context the responses are 8.0 percent and 10.0 percent respectively under the sample villages under Tata steel limited and Bharat coking coal limited.

Coal mining in the Jharia coalfield have not only a qualitative aspect but there is a quantitative aspect of this mining process since continuous discharge of underground water for coal exploration depleted the water table in the region of Jharia coal fields and increases the demand and supply gap amongst the stakeholders. In many mines the rate of water percolation even in critical summers heavy and needs to be pumped out to the surface basic as a mine drainage operation.

This mine drainage process also observed in the open mines pumping out huge volume water from the underground is definitely taking its toll in the depth of water level in the open dug wells and tube wells of the surrounding areas. Since the mines acquire natural water reservoirs to fulfils their needs.

These reservoirs are sometimes the only source of usable water for the people for their domestic and agricultural needs. The requirement of water in mining industry put additional pressure on available water

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resources and due to this people are in turmoil as their water resources are depleting very fast. Mining involves the use of a large amount of water, the source of which sometimes is the groundwater. The large-scale use of the groundwater results in lowering of the water table creating problems for the nearby regions that use wells and hand pumps for their daily water requirements. Also, in underground mining, the development process may come in level with the water table during which the water has to be removed or diverted causing the destruction of the water table in both cases as reflected in the impact of coal mining on the water table as illustrated in Table 4.

The scenario of water crisis is very much of a panic and pain-full nature since it is not only a social point of view, but with it has an economic curse also within amongst the stakeholders of BCCL and this coal fields at large, this Jharia coalfield blessed with prime coking coal deposits, developing nation with a thirsty throat amongst the community-dwelling in the surrounding. The initiatives of BCCL amongst the project areas does not seem to be adequate and satisfactory, leaving the wide gap to fill up under the initiatives it could come with its CSR interventions, just thinking beyond business.

The companies should develop a committed mechanism to have vigil on the qualitative and quantitative aspects of the surface and groundwater in the region, these could be achieved by regular vigil on the depth to water level of the dug well and tube wells, to routine sampling in the pre-post monsoon periods of the water sample from both the surface and groundwater should be collected and proper chemical analysis of the samples for related parameter should be done with the help of eligible and component government agencies or through private dedicated agencies.

This will help to understand the specific requirement of the community i.e. where how much attention is required and qualitative aspect of water and where and what quantum of water should to be supplied and by what means i.e. either by tankers, pipeline water supply of sinking wells, tube wells and excavations and renovations of existing water bodies, pouring the ponds with supply from mine water suitably treated, would definitely crop up concrete plan of action to mitigate the crisis gravely faced by the community. The villager's dwellings in the operational area of BCCL faces acute crisis and are often bound to consume non-potable mine water.

The women and even the male member of the community spends a quarter of the day for the arrangement of water from distant places this becomes even worst in the summer.

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Impact of coal mining on flora and fauna

The vegetation in areas closer to coal mines may face hard disturbances (Huang, et al., 2014). Ecology is negatively impacted by coal mining activities due to decreased ground water level, loss of productive soil layer and vegetation (Zhengfu et al., 2010).

Coal mining is commonly linked as a cause behind dilapidated condition of natural resources and the damaged habitation. This causes invasive species to occupy the area, thus posing a threat to biodiversity (Sribas, 2015).

In the forest areas increased coal mining activities led to the reduced forest cover and at the same time affecting bio- diversity and wildlife corridors also. According to the Ministry of Coal (MoC), forest areas are having approximately 60% of coal resources (MoC, 2005).

In the opencast mining large tracts of land is required for coal extraction processes and also for industrial purposes like captive power plants and thermal power plants, as well as for ancillary processes also such as pipelines, railway lines, public works and OB dumps. It destroys not only the standing forests but also animal corridors, which diverted the streams (Mishra, & Das. 2020).

The displacement of species in excavation and waste heaping areas of coal mining is the most direct effect faced by wild – life. From the villagers point of view it leads to the extinction of most of the wildlife species found in the area and many mobile wildlife species like birds, predators and game animals have also left these areas.

Many reptiles and invertebrates, small mammals and burrowing rodents who are more sedentary are harshly affected. The fragmentation of habitats due to mining activities has made difficult for some animals for their ecological move (Mishra, & Das. 2017).

For efficient manage of air pollution at cause and other mitigate way suggested including carrying out of green belts around the sensitive areas where the concentration of air pollutants go beyond the standard limit (Chaulya, 2004).

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Table 5

Impact on flora / fauna and level satisfaction with the initiatives

Particulars	Responses	TATA		BCCL	
		Count	Column N %	Count	Column N %
Impact of Coal Mining on Local Flora and Fauna	Extremely	91	60.7%	114	76.0%
	Moderately	23	15.3%	26	17.3%
	Slightly	36	24.0%	10	6.7%
Level of Satisfaction for the Initiative undertaken by TATA and BCCL in Restoring of Local Flora and Fauna of the Region	Extremely dissatisfied	83	55.3%	121	80.7%
	Dissatisfied	51	34.0%	23	15.3%
	Satisfied	16	10.7%	6	4.0%

(Source: Primary)

Table 5, illustrates the opinion of the respondents under the sample villages from Tata steel limited and Bharat coking coal limited that to what extent the coal mining activities carried out by TATA and BCCL affected the local flora and fauna. The majority of the respondents over 60.7 percent from the sample villages under TATA and 76.0 percent under the sample villages under BCCL opined that mining activities has extremely affected the local flora and fauna existence, while 15.3 percent of the respondents from the sample villages under TATA and 17.33 percent from the sample villages under BCCL opined that the mining activities carried out by TATA and BCCL moderately affected the local flora and fauna. While only 24.0 percent and 6.7 percent respondents from the sample villages under TATA and BCCL respectively opined that the mining activities carried out by these companies slightly affected the local flora and fauna.

Further the Table 5 also depicted that only 10.7 percent of the respondents from the respondents under the sample villages under TATA seems to be satisfied with the initiatives undertaken by the TATA but the respondents under the sample villages under BCCL it is merely 4.0 percent respondents feel satisfied with the initiatives undertaken by BCCL, while 34.0 percent dissatisfied with the initiatives undertaken by TATA for the initiatives undertaken to restore the local flora and fauna and 15.8 percent respondents were dissatisfied under the (sample) villages from BCCL. It is of imperative to note that about 80.7 percent of the respondents under the sample villages under BCCL are strongly dissatisfied with the operational measures and initiatives undertaken by the BCCL to restore the local flora and fauna in the region.

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Although the data for strongly dissatisfied from the respondents from the sample villages under TATA also reveals in the higher side with 55.3 percent of the respondents do feel strongly dissatisfied with the initiatives undertaken by Tata steel limited to restore the local flora and fauna species in the region although as comparison to the responses from BCCL it is significantly low.

Conclusion

It was evidently noted through the analysis of responses of the community in their respective buffer zones, field observations that the adverse impact on land and soil is more in the operational areas under BCCL than that of the TATA, while level of satisfaction of respondents is found be higher for measures and initiatives undertaken to address these issues through corrective measures where in inclined towards TATA, the similar trend of responses were outcome of analyzing the responses regarding measures undertaken to minimize the impact of Coal Mining on Air Quality by various measures of water sprinkling, transportation of coal by trauplin covered trucks etc, the respondents seems to be quite satisfied by the measures undertaken by TATA that when compared to respondents for BCCL under their respective domain of sample villages. As huge quantum of ground water is pumped out for mining operations it is quite obvious to note that the impact of coal mining on both water quantity and quality is appreciably negative, and hence the measures for water conservation by these mining companies were reviewed, here also TATA company was witnessed to have taken measures like re-excavation of ponds in the sample villages under their realm but BCCL no such actions for restoration of aquatic environment and water conservation measures were recorded from the sample villages under BCCL. Both the coal companies acts in the direction of minimizing the impact of coal mining on flora and fauna and hence undertake plantation, afforestation, TATA company also in association with the community carry out such measures by providing tree sampling and horticultural plants to the surrounding community and hence a comparatively better level of satisfaction is manifested by the respondents than of the BCCL. However both the coal companies should focus judiciously to ensure least damage of the splendid environment rich in mineral resources, which is showering colourful currencies to them and should act accordingly to maintaining its greenery and other resources essential for surrounding environment to sustain including the human resources.

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