IMPACT OF EXTRACTIVE INDUSTRIES ON LOCAL BIODIVERSITY: A SOCIOLOGICAL ANALYSIS

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Introduction

The Indian mineral sector plays a vital role not only to generate employment opportunities and improved livelihoods, but contradictorily enough also to create considerable environmental degradation. Moreover, the central impact of mining is long term and devastating as it not only shades negative impacts on local air and water quality, but also causes depletion of natural resources, decrease in rainfall, loss of cultivable land, etc. (OECD 2002). As per the official confirmation by the Ministry of Mines, the country is bestowed with 87 minerals. Of them, it is the prime contributor of mica, coal, lignite, iron ore, bauxite, manganese, aluminium and crude steel (MOM 2013a). Among these mineral reserves, coal has occupied a vital place by fulfilling around 55 per cent of India's energy requirements (MOM 2013b).

To meet the energy needs of the country, the excavation of coal is being commercialized and at the same time varieties of coal extracting industries have been established. Through the customary practice of mining coal, the country is earning good revenues but, at the same time, it has resulted in serious health and environmental issues (Altmann et al 1999; CSE 2008 and Guha 2014).

Extractive industries, mainly coal mining, generate negative impacts in the local ecological conditions, which adversely affect the local economy and threatens the sustainability of local livelihood systems. The post-mining phase of the IB Valley has broadened the realm of cost-effective industry but studies based on raw materialistic approach also suggests that impacts of coal mining must be conceptualized through the perspective of resource curse/blessing;

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additionally, it is important to note that the scale and dimension of mining is always in question. Exploitation of natural resource endowment shows the negative social and ecological outcomes. The study of Ramsay (2011), Rossi (2011) and Williams (2011) shows the several negative impacts of resource extraction in global scenario. The Hota and Behra (2016) study also suggests that there is need to reinvest some part of resource rents in regeneration of natural capital of the region but the results of their study also show that rural households in the mining area experience both positive and negative outcomes from the coal mining activities. The Deonandan and Dougherty (2016) study of mining impacts in Latin America raised a range of questions about the practices of mining companies on the ground, with the impacts of mining on host communities in terms of livelihood and capabilities being very critical. They mention that a century of mining operations is the reason for the disappearance of the forests, rivers and lakes. Nielsen and Oskarsson (2016) shed light on the crucial political and social dynamics that unfold today as India seeks to accelerate industrial growth. They show how the State stimulated the rural land for mining and ignored the assets of natural capital. The study shows that the destruction of the natural resource base was one of the general reasons for resistance.

Starting from its excavation to loading and unloading, coal produces dust and radiation which has a direct negative impact on the ecology, biodiversity and health of the surrounding communities (Chaulya et al 2011). During drilling, blasting, sizing and transportation the release of total suspended particulate (TSP) matter and inhalable particulate (PM^{10}) are the reason for air pollution in and around the mining zone (Chaulya 2003). To check the air quality of the coal mining regions in India, a study was being undertaken by the Ministry of Environment and Forest (MOEF), Government of India. According to the report prepared by MOEF, the critically polluted areas of India due to coal mining are Korba, Anugul, Talcher, Hazaribagh-Chatra, Singauli, Chandrapur, Raigarh and Jharsuguda (MOEF 2009). The Central Pollution Control Board (CPCB) has developed a Comprehensive Environmental Pollution Index (CEPI). The CPCB has done a nationwide environmental assessment of industrial clusters based on CEPI and 43 such industrial clusters having CEPI greater than 70, on a scale of 0 to 100, have been identified as critically polluted. In Odisha, three clusters—Angul-Talcher, Jharsuguda, IB Velley—came under the category of critically polluted. Among these three regions, Angul-Talcher secured the highest position acquiring a score of 82.09 CEPI (SPCB,

2016). Even recently, CPCB has claimed that the Angul-Talcher region is a critically polluted area in Odisha, where pollution is caused primarily due to Bhusan Energy, Nalco Smelter, Bhusan Steel and MCL's Bharatpur and Bhubaneswari mines (*The Pioneer*, 17 June 2017). The central reason behind the pollution of air is the release of suspended particulate matter (SPM) (TERI 2013).

In India, the central producer of coal is Coal India Limited (CIL) which operates at eight different stations. They are excavating coal through both opencast and underground techniques. However, the opencast mines are the major producer of fugitive dust into the air which ultimately pollutes the air environment (Katoria, Sehgal & Kumar 2013). Sometimes, the assessment of air quality shows that the air quality of both the residential and industrial areas surpasses the National Ambient Air Quality Standard (NAAQS) protocol. A study done by Chaulya (2004a) in the IB valley coalfield region of MCL shows that the 24-hour average of TSP and PM_{10} is much more than the prescribed limit of NAAQS. Even the study done by CMRI Dhanbad during 2012-13 concluded that the emission of TPM at the mines of Mahanadi Coalfields Limited (MCL) is because of the release of contaminating dust (MCL 2014).

The long-term and continuous mining of coal degrades the natural environment and wreaks negative impacts on the nearby water bodies and soil (Guha 2014). However, the regular disposal of vast quantities of waste water into the nearby water bodies is the main cause of pollution of water (Singh, 1998). More specifically, the release of chemical particles with the waste water is the reason behind alteration of water regimes (Reza and Singh 2010). Above all, the chemical particles' contamination of water through Acid Mine drainage (AMD) is the reason behind the alteration of pH balance. Even the low pH balance is the reason behind the hazardous condition of aquatic life (Swer & Singh, 2004). Further, the presence of metallic materials such as iron (Fe), copper (Cu), manganese (Mn) and nickel (Ni) hinder the domestic use of water (TERI 2013).

Pollution of both surface and ground water is becoming rampant due to coal mining activity. During the initial period, the release of toxic substances such as ash, oil, phosphorus, ammonia, urea and acids contaminated the surface water quality of the mining regions (Reza and Singh 2010). Studies have found that the ground water quality is also getting contaminated due to the release of manganese (Mn), cadmium (Cd) and lead (Pb). The concentration of these metallic particles was found beyond the maximum permissible limits (Senapati & Behera, 2012). Similarly, the presence of these metallic substances in water is resulting in various health hazards such as

rheumatism, speech and hear disability, euphoria, impotency, high blood pressure, high cholesterol, diabetes, kidney stones and cancer (Dara 1993 and Mishra 2012). Sometimes, over-exploitation of water from the nearby water bodies also becomes the major cause of water scarcity (Aitken 2016).

Noise pollution is quite evident in connection with coal mining. As mining activity is taking place throughout the day, the noise coming out at the time of blasting, drilling and transportation pollutes the entire environment. Mostly because of opencast mines, the noise comes out at the time of blasting and overburden removal (Saviour 2012). The workers working in the polluted environment where they are continuously exposed to noise, humidity, unhealthy ventilation, smell of chemical explosion, etc. are also getting adversely affected (Naik and Pradhan 2010).

Since Independence, raising the access to and higher utilization of health, family welfare and nutrition services has been one of the major thrusts for social development in India. But the development projects which have been initiated to expedite economic development have invariably proven to be injurious as far as people's health is concerned (Appiah and Buaben 2012). Among development activities, mining plays an important role in boosting the economic profile of a country (Yeboah 2008). As a result of mining, a diverse range of challenges have occurred. In spite of voluminous growth, both in the fields of medical science and health, environmental factors remain a major cause of disease and death globally. The continuous release of several pollutant particles causes climate change on a wider scale (Castleden et al 2011). Ecological imbalance is also adding one more facet to environmental pollution (Fashola et al 2016). Hence, it can be stated that the economy cannot be fortified in its truest sense while the broader impact of mining is felt on the environment (Obiri et al 2016).

However, all these issues can be tackled by formulating and implementing the appropriate policies for the project-affected communities. Time and again, policies have been formulated but the improper distribution of resettlement and rehabilitation (R & R) measures have resulted varied kinds of distress among the affected communities. In the light of the above, the present paper addresses the major environmental issues that are being encountered by the project affected people of the Talcher coal field. Here, we have tried to assess the impact of mining on local environment from a sociological perspective.

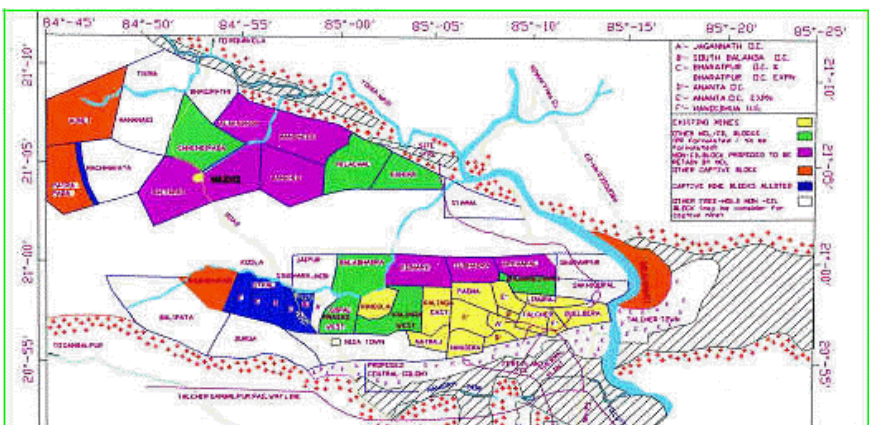
To the above background, the present paper is an attempt to

discuss the following environmental aspects of coal mining in the Talcher coalfield region:

- The reasons behind environmental degradation.
- The impact of coal mining on local environment, including air and water.
- The impact on the health of local communities.

Materials and Methods

The present study was carried out in Mahanadi Coalfield Limited (MCL) region of Odisha, India. MCL, a subsidiary of Coal India Limited (CIL), has three functioning areas: Talcher, Ib Valley and Vasundhara. The present study is confined to the open cast mining areas of MCL Talcher.



Map: Talcher Coalfield
Source: http://mahanadicoal.nic.in

Talcher coalfield, bounded by latitudes 23*53'N & 21*12'N and longitudes 84*20'E & 85* 23'E, covers an area of about 1800 sq.km. It has eight open cast and three underground coal mines in its five coal areas namely Jagannath area, Bharatpur area, Lingaraj area, Hingula area and Talcher area.

In this present study, the targeted population consists of those who bear the negative costs of mining. In the first stage, listing of all the villages near the mines was undertaken. Given the choice of a target population, the next step was to put together a list of the target population, known as the sample frame population, from which, ultimately, the sample was drawn. Secondly, a listing of six villages was undertaken according to stratified random sampling procedure.

The strata were decided on the basis of the distance from the mine. The significance of selection of the villages in this particular way is to capture the variations in the impact on livelihood due to mining activities.

The closer a village is to the mines, the more is the probability that it is affected by the mining. Since mines have started operation 20 years ago, it is difficult to go for a 'before and after' analysis. Instead, a 'with and without' comparison will be carried out. For the purpose of with and without comparison, two more villages were selected that have not been affected by mining but belong to the same district, as control villages. In the last stage, from each sample village, households were selected on the basis of circular random sampling methods for the final study.

Table 1: Sample Villages

Samples	*No. of Villages*	*Distance from vicinity*	*No. of Sample*	*Total Sample*
Affected by mining (Experimental group)	2	3	75@2	150
	2	6	75@2	150
	2	9	75@2	150
Non-mining affected (Control Group)	2		75@2	150
Total				600

Source: Field Study

In order to fulfil the objectives of the study, data was collected from both primary and secondary sources. For primary data collection, apart from quantitative techniques, the present study used qualitative anthropological tools. As part of qualitative data collection, the techniques like observation (both participant and non-participant), case study, key informant interview, formal and informal interviews, and some of the PRA techniques like focused group discussions, resource maps and seasonal analysis were used. For gathering quantitative data, household survey was conducted using the pre-tested schedules. The secondary data was collected from official records, policy documents, published reports of similar projects, journals and literature form social science disciplines.

Coal Mining and Environment

Over the course of time, many environmentalists have come to agree that burning coal is the most polluting method for producing

electricity, and that it is causing huge environmental damage. The worst thing that occurs during this process is the production of greenhouse gases, mostly carbon dioxide emissions. However carbon emissions are not the only negative thing in this process, as it also involves the release of various other harmful compounds. Besides the burning process, environmental problems are also associated with transportation, storage and disposal, loading and unloading, blasting, etc. Since coal is predominantly mined from the surface of the earth, this often causes damage to nearby ecosystems as many of the ecosystems above are degraded or sometimes even completely removed. Coal is usually transported by diesel trains over great distance which means that it releases extra carbon dioxide and other harmful particles. And there is also coal dust that, once produced, contributes to particulate matter in the air which ultimately causes air pollution.

The trace factors contained in coal (and others formed during combustion) are a large group of pollutants with a number of health and environmental effects. As a result it disturbs ecosystems and endangers human health as well. Some cause cancer, others impair reproduction and the normal development of children, and still others damage the nervous and immune systems. Many are also respiratory irritants that can worsen respiratory conditions such as asthma.

Coal Mining and Air Pollution

In the 21st century, the region under study has become an industrial hub. Along with MCL, a good number of coal-based thermal power plants, several heavy industries, coal washeries and a large number of subsidiary industrial units have come up in the area. All these mining and industrial activities have caused rapid degradation of environmental quality. While on the one hand the natural resources available are degrading very fast, the demand for resources have risen in the locality because of the rise of industries and the inflow of outsiders.

Across the globe, mining activities have either direct or indirect association with air pollution (Roy and Singh 2014). Although the effect of mining varies, the negative impact of opencast coal mining is much higher than that of underground mines. Activities such as drilling, blasting and transportation are the central cause behind air pollution (TERI 2013 and Higginbotham et al 2010). Even the release of fugitive dust into the air is also responsible for air pollution (Katoria, Sehgal and Kumar 2013). In this present study,

it has been observed that all the open cast mines are directly or indirectly contributing to the air pollution in the mining-affected villages, through the release of particulates and poisonous gases. Even the associated activities such as unloading and loading of coal, transportation of coal, the poor condition of roads and huge quantities of open air coal burning by the villagers have contributed to air pollution.

In all, in the affected villages and the nearby areas, it was observed that airborne emissions occur during each stage of the mine cycle, but especially during exploration, development, construction, and operational activities. Mining operations generally mobilize large amounts of material and waste piles, containing small size particles, which are easily dispersed by the wind. The largest sources of air pollution in mining operations are particulate matter transported by the wind as a result of excavations, blasting, and transportation of materials, and wind erosion fugitive dust from tailings facilities, stockpiles, waste dumps, and haul roads. Exhaust emissions from mobile sources (cars, trucks, heavy equipment) also raise these particulate levels. On the roads, the movement of heavy vehicles carrying coal was seen aggravating air pollution. It was also noticed that during transportation, the coal loaded vehicles were usually uncovered. Even the trains which transports coal from the source point to the designated place poses serious threats as the loads are literally left uncovered. It was apparent that MCL authorities are not concerned about monitoring the uncovered vehicles. In a discussion, MCL officials blamed the State authorities for not monitoring these issues. They claimed that around 85 per cent of coal is being transported through train and only 15 per cent coal is transported by truck to local industries because of the MoU with the State Government. They also claimed that till the MCL gate they used to monitor and are giving clearance certificate, but the truck drivers remove the cover once they cross the MCL gate.

However, during the field study, it was observed that almost all coal loaded trucks were uncovered. Interestingly, when the drivers were asked whether they were directed to cover the coal loads at the time of transportation, they replied that no such directions were given at the time of loading and neither have they paid any penalty for the same. Though there was an agreement that a separate coal corridor road will be built, it is not yet ready. Villagers in the study area revealed that sprinkling of water to prevent dust from flying never occurs and they have to breathe the polluted air which is extremely damaging to their health. MCL has openly flouted the

pollution control board's norms by allowing overloading of vehicles, which in turn generate large amount of dust particles due to spillage. In a clear violation of the Environment (Protection) Act 1986, the authorities have not made any provision for the collection of such spilled coal materials which has become another source of pollution.

Table 2: Respondents Response on Pollution

Name of the village			
	Yes	No	
Balanga Khamar	73 (97.33)	2(2.67)	75
Langijoda	59(78.67)	16(21.33)	75
Hensmul	75(100.0)	0	75
Naraharipur	75(100.0)	0	75
Danara	72(96)	3(4)	75
Jambu Bahali	75(100)	0	75
Total	429(95.33)	21(4.67)	450 (100)

The data collected from the field reflected in Table-2 shows that around 95.33 per cent households reveal that mining has polluted their local environment. As there is not much variance in responses, the questionnaire can be deemed to show high reliability.

During summer, the temperature in Talcher remains between 42 and 48 degree Celsius, while at the same time mine fires also add to the heat of the summer. The release of huge stocks of coal from Lingaraj, Bharatpur and Ananta mines cause regular mine fires. Sadly, the failure of MCL authorities to contain the fires has worsened the situation. The regular occurrence of fires has aggravated the atmospheric heat as well as the environmental pollution. In this situation, it is necessary to dispatch the produced coal as soon as possible without it being stored, or kept in stock, both of which can lead to fire and smoke. MCL authorities are well aware that the dust particles which released into the air are dangerous, but the authorities are inactive in terms of paving the way for a permanent and strategic method for countering the menace of dust-related hazards. From the available official data of MCL, they claim that varieties of measures have been taken to encounter air pollution. Such measures apparently include the use of blast-less mining technology which eliminates dust generating operations like drilling, blasting and crushing completely, while sprinkling water at the same time. However, in practice there is hardly any use of blast-less mining

technology nor is there any consistency in water sprinkling. Another mitigation measure claimed by the MCL includes mist-type water spraying system along the conveyor belts/bunkers in the major coal handling plants, but hardly any mist type water system was found during the field study.

In order to reduce the fugitive dust emission, the MCL has started using Surface Miner Machine, while earlier it used to depend entirely on the normal mining method. However, it was observed that the majority of its mining activities are still dependant on the conventional method. Further, roads for coal transportation are not much equipped with water spray systems. The maintenance of fixed and mobile water sprinklers on roads, railway sidings, stock yards, etc. are also not done by the MCL in a regular fashion. It should be a compulsion that both sides of the road should have sufficient number of water sprinklers which was not seen in the Talcher coal field. Only in some occasional cases, some tanks are moving on roads to sprinkle water. The lack of seriousness of MCL regarding the installation and strengthening of existing dust collectors and dust extractors in drills raises serious concerns.

Crushed Coal from CHP or directly from surface miner face is transported through tippers which unload the coal on the platform. Then, paid loaders load the coal in the wagon. Due to the unloading, loading and movement of a number of tippers, railway sidings become a major source of fugitive dust emission. Though water sprinkling through mobile and fixed sprinklers and good housekeeping through plying of wheel dozers are used to control the dust at railway sidings, still pollution is a major challenge here. Even the mining affected villagers reported that MCL has openly cut lakhs of trees and has never planted a single plant in their villages. Trees not only yielded fruits for them but also purified the atmosphere. This demonstrates how MCL has openly disobeyed environmental laws and is not seriously engaged in any afforestation programmes for the betterment of the environment.

Table-3 reveals that around 96.44 per cent villagers responded by saying that MCL is not taking any mitigation measures in order to apprehend the pollution caused by mining operations. Villagers also added that the MCL claims about implementing mitigation measures, such as the use of blast less technology and use of water sprayer, in the affected villages were nothing but white lies and MCL has been violating the environment laws and its mitigation claims are totally baseless. However, during fieldwork, it was observed that though MCL has taken lots of effort to control pollution, it failed to

Table 3: Respondents response towards MCL's initiation to mitigate the pollution caused by mining

Name of the village	*MCL taking initiatives to mitigate pollution*		*Total*
	Yes	*No*	
Balanga Khamar	6(8)	69 (92)	75(100)
Langijoda	5(6.67)	70(93.33)	75(100)
Hensmul	5(6.67)	70(93.33)	75(100)
Naraharipur	0	75(100)	75(100)
Danara	0	75(100)	75(100)
Jambu Bahali	0	75(100)	75(100)
Total	16(3.56)	434(96.44)	450(100)

reach a proper solution.

To examine the existing air pollution scenario, the present study has taken the 10-year air ambient quality data measured by State Pollution Control Board, Odisha (SPCB). As per the study conducted by Goswami, (Goswami et al 2010), SPM had reached an alarming level of 1848 kg per square km in Talcher region in Odisha. The data collected from Odisha Pollution Control Board shows that nitrogen dioxide (NO2) and sulphur dioxide (SO2) levels for most of the coal mining areas are within the prescribed limits, however, high concentration of suspended particulate matter (SPM) and dust levels is a major problem in and around the mining areas of Talcher. Fugitive dust emissions, in particular, have been a major cause of concern.

Periodic sampling of air quality is being done by the State Pollution Control Board under the sub section (2) of section 29 of the Air (Prevention And Control Of Pollution Act, 1981). A brief comparison is made using their sampling results for Jagannath Open Cast Project which is presented in Tables 4 and 5, and can be considered as a representation for the other opencast mining working in the surrounding region of Talcher Coalfield. The highest concentrations of particulate matter are found within the mine with concentrations gradually diminishing with increasing distance from the mine (Trivedi et al., 2009), hence the expected concentration within the Jagannath Open Cast Project is much higher than the values reported in the above tables.

From the tables, it is also observed that the concentration of these particulate pollutants has been consistently increasing throughout the last decade. The SPM concentration is alarmingly high at all

Table 4: RSPM (PM10) and SPM concentration in µg/m3 (Jagannath Open Cast Project)

Site Name	*03/ 2004*	*04/ 2005*	*02/ 2006*	*04/ 2006*	*03/ 2007*	*03/ 2012*	*02/ 2013*	*10/ 2013*	*01/ 2014*	*03/ 2014*
Time Office	ND	ND	ND	ND	ND	225	210	215	340	229
Project Office	ND	180	295	275	171	ND	ND	ND	ND	ND
Colony	ND	ND	ND	ND	ND	135	195	163	209	266
Central Nursery	144	83	ND	140	ND	ND	ND	ND	ND	ND
Field Canteen	ND	ND	ND	ND	ND	ND	215	220	369	243
RSPM Standard: 300 µg/m3										

ND = No Data

Table -5: SPM concentration in µg/m^3
(Jagannath Open Cast Project)

Site Name	*03/ 2004*	*04/ 2005*	*02/ 2006*	*04/ 2006*	*03/ 2007*	*03/ 2012*	*02/ 2013*	*10/ 2013*	*01/ 2014*	*03/ 2014*
Time Office	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Project Office	ND	307	991	699	616	ND	ND	ND	ND	ND
Colony	ND	ND	ND	ND	ND	455	583	505	455	734
Central Nursery	352	162	ND	398	ND	ND	ND	ND	ND	ND
Field Canteen	ND	ND	ND	ND	ND	ND	594	551	766	458
SPM Standard: 600 µg/m^3										

ND = No Data

the sampling locations, whereas RSPM concentration, which once used to be within acceptable limits, is now gradually approaching its standard acceptable value of 300μg/m^3. In some cases it was observed that RSPM has crossed the standard limits. The rise of SPM in Jaganath colony which is a residential area is a matter of serious concern. The SPCB data of other mining areas shows that both SPM and RPM have crossed the minimum level even in most of the residential areas. The 2014 data collected from Hensamul village of Bhubaneswari mine and Kumuda village of Lingaraj mine shows that both SPM and RPM levels have crossed the minimum level in all the villages.

Water Pollution

Another ill effect of coal mining is its impact on the water resources which, perhaps, is the most important aspect as far as the life of the villagers is concerned. Villagers in the affected villages claimed that coal-related waste and coal sludge are often injected into the nearby water bodies which make the water unfit for domestic use. The ponds which the villagers used earlier as a bathing *ghats* exist no more as water has either dried up or the water bodies have been heavily contaminated by the coal-associated waste materials. A few learned villagers also claimed that erosion normally causes loading of sediments which has chemical pollutants that causes a variety of environmental issues. In each and every mining affected village it was witnessed that waste heaps, which consist of waste rocks, may have coal-associated waste which can enter the ground water through leaching and may cause contamination of ground water. Villagers also expressed that they have experienced a change in the taste of drinking water.

Coal mining has not only disturbed the water quality in the villages but has also caused water scarcity. As mining activities require large quantities of water, the availability of water is facing a crisis. An average of 86.26 million cubic meters per annum is drawn from the river for industry/mining activity in Angul-Talcher region of Odisha (Reza and Singh 2010). Many coal mining regions are reported to confront the problem of over exploitation of ground water resources which has in turn decreased the water table (TERI 2013d). Villagers are very skeptical of the MCL's role for the preservation of water resources in their respective regions. A few villagers have also reported that MCL is continuously exploiting the ground water resources in a continuous manner which has affected the water table in their area. They cited

the example of their existing tube wells which they claimed now give out water only after 15 minutes of pumping which is a big variation from before. The villagers claimed that the wells, tubewells, ponds and streams in the mining affected villages are drying up due to the intense exploitation of water for mining operations. They claimed that before mining activities started in this area they used to have water hardly 3/4 metres below the ground and almost all bore wells used to remain functional even during summer. However, now in the summer season, all the tubewells become dysfunctional and they face acute shortage in safe drinking water.

We were unable to get pre-mining water table data but the present data reveals that the water table has gone down in comparison to the people's claims. During the pre-monsoon period, the water table has fallen to around 7/9 metres below the surface (Table-6).

Table 6: Water Table data for the year 2014 (Angul-Talcher Belt)

Location	*Longitude*	*Latitude*	*Pre-monsoon*	*Post-monsoon*	*Fluctuation*
Ghantapada	85.1690	20.9293	7.95	3.15	4.80
Balanda	85.1555	20.9230	7.75	3.28	4.47
Santhaparha	85.2222	20.9036	8.45	5.15	3.30
Talcher	85.2305	20.9472	9.65	4.45	5.20
Gourmara	85.2130	20.8548	8.85	3.85	5.00
Kularha	85.1671	20.8399	6.35	2.35	4.00
Turanga	85.1241	20.8483	6.45	2.75	3.70
Barha Singarha	85.1347	20.9198	7.80	2.65	5.15
Donara	85.0961	20.9439	6.35	2.77	3.58
Raghunathpur	85.1537	20.9899	4.75	2.65	2.10
Sendhogram	85.2331	20.9259	7.45	5.25	2.20
Bhogaberni	85.2139	20.8917	8.65	5.15	3.50
Kukurhanga	85.1485	20.8948	7.75	2.45	5.30
Tentulia	85.1728	20.9191	7.85	3.46	4.39

Source: Central Ground Water Board, Bhubaneswar
Note: 'm bgl' = meters below ground level

The investigator has taken opinions from 450 households about the sources of water pollution in the mining affected villages. Around 41.34 per cent of the households stated that dumping ash is the major source of water pollution in the area and 22 per cent reported that mining water seeping into existing water sources is the major cause. They also claimed that this was not found in the

control villages because the control villages are far from the mining. When asked if MCL has attempted any mitigation measures such as putting bleaching powder in the water sources, more than 80 per cent of the villagers reported that such measures have never been undertaken. Again, more than 80 per cent of the villagers claimed that MCL is not complying with the water recycling norms nor is bothered to look into the condition of the water that has emerged due to the constant generation of dust and ash which settles in the water sources of the villages.

Table 7: Sources of water pollution

Sources of water pollution	*Frequency*	*Percent*
Mining water going to existing water sources	101	22.4
No recycling	60	13.33
Dumping ash	186	41.3
All	103	22.9
Total	450	100.0

Source: Field Study

Mine drainage water pumped out of the mine as well as the water flowing out from OB dumps is collected into settling ponds before being discharged, in order for the sediments to settle and to prevent silting of rivers and other water bodies. The villagers further added that often the oily sludge which comes out during mining operations mixes with the water resources. Water effluents are not properly treated and no water recycling is done by MCL. It was also found that there are tankers which supply water to the villagers but the amount as well as the frequency of water supply by the MCL is undependable and during summer, many households do not get even a bucket of water for domestic purposes as other water sources have completely dried up due to the exploitation caused by the MCL. During transportation of coal, the spillage of coal often comes in contact with the water bodies and drains which is a major source of pollution in the area. MCL claims that they are trendsetters in terms of mitigation of pollution, but hardly any such thing was found during the field study and the responses of the villagers prove the alleged inaction of the MCL in terms of controlling water pollution in the area. It also came to light that several kinds of demonstrations as well as many complaints have been written seeking the intervention of MCL authorities against the backdrop of water menace, but MCL has paid no heed to the just demands of the villagers.

On the contrary, the control villages, viz. Sradhapur and Deraguda, offer a different picture from that of affected villages. During field investigation in the control villages, 96 per cent of the villagers responded that there is no water pollution in their locality and they have still got access to clean and pure water. The ponds in their area have good amount of water which is fit for bathing. Water for domestic purpose is in abundance as there are number of tube wells which give out good amount of water even during extreme summers the villagers exclaimed. Also, activities such as the cleaning of the ponds are done in a regular fashion and the villagers are very happy about the fact that their water sources for bathing, washing and other domestic purpose are not polluted and are in the position of status quo since time immemorial.

In order to strengthen the argument and assessing the impact of mining on the local environment, the existing water tested data on Talcher coalfield was collected from SPCB, Bhubaneswar, Odisha (Table 8).

Both the BOD and COD tests are a measure of the relative oxygen-depletion effect of a waste contaminant. Both have been widely adopted as a measure of pollution effect. The BOD test measures the oxygen demand of biodegradable pollutants whereas the COD test measures the oxygen demand of biodegradable pollutants plus the oxygen demand of non-biodegradable oxidizable pollutants. The data presented above shows that suspended sediments and COD in most of the mining areas and BOD in a few cases have crossed the specified standard. Aquatic life will be disturbed due to reduction in photosynthesis, high suspended sediments, COD and BOD.

Drainage of mine water to various streams and rivers have affected the aquatic life. Many wildlife species are highly dependent on vegetation growing in natural drainages. This vegetation provides essential food, nesting sites, and cover for escape from predators. The development of mining projects has destroyed vegetation near ponds and reservoirs, and reduced the quality and quantity of habitat essential for waterfowl, shore birds, and many terrestrial species. The loss of habitat requirements have made many animals unable to adjust to changes created by land disturbance, and as a result, it has reduced wildlife.

Noise Pollution

Coal mining is a loud, day-and-night process that includes blasting,

Table 8: Water Effluent Quality Data in MCL region of Talcher

Name of mining	*Sampling Date*	*Sampling Point*	*Parameters (mg/l)*				
			PH	*SS*	*BOD*	*COD*	*O&G*
Bhubaneswari OCP	30/10/2013	a) outlet of sedimentation tank discharged to banguru nallaha	7.3	28	4	27	—
		b) Outlet of ETP discharged to UG tank	7.4	1266	8	32	–
		c) Out let of O&G trap	7.0	44	4	11	5
		d) bangaru setu near BCML workshop	8.1	28	4	11	–
	22/07/2014	outlet of sedimentation tank discharged to banguru nallaha	6.8	155	4	24	—
Lingaraj OCP	30/12/2014	a) treated workshop effluent discharged to outside nallah	6.4	136	27	–	12.8
		b) final effluent discharged to outside nallah	6.6	122	22	–	10.4
Bharatpur OCP	01/02/2013	a) Outlet of workshop ETP	7.6	26	8	64	–
		b) outlet of ETP,village nallaha and Balram pipe leakage to banguru nallaha	7.8	28	16	224	–
		c) Outlet of STP	6.8	24	24	160	–
		d) Outlet of railway siding runoff discharge to banguru nallaha	6.8	1826	12	288	–
	14/03/12	a) Treated workshop effluent discharged on outside land	6.6	146	82	22	14.2
		b) Outlet effluent of STP discharged on outside land	7.2	43	163.8	32.4	—
Jagannath colliery Balanda	01/02/2013	a) Workshop ETP outlet	6.1	76	20	288	—
		b) Outlet of mine drainage treatment plant	7.3	24	8	128	—
Standard			6.5-9.0	100	30	250	10

Source: State pollution Control Board, Odisha

drilling, and continual moving of heavy vehicles. These mining-related activities have resulted in emission of loud noise which has disrupted the lives of those in the surrounding communities and has reduced the quality of life (Saviour 2012). During field investigation there were clear evidences that the ill effects of mining not only affected the environment but human habitats as well. Blasting, which is done for coal extraction, shakes the ground up to some distance around the blast site. Residential properties around the quarry have experienced significant increases in the effects of blasts. Villagers were very sad about the fact that they had invested huge amounts of money for their houses but the vibration which emerges due to mining has given the villagers a big jolt. More than 60 per cent of villagers expressed that blasting related operations are making the children terrified and has brought disturbance to their studies. According to some residents, they could not sleep at night because of the blasting and the fact that heavy-duty trucks operate virtually all night to cart coal to the company's plant.

Villagers as a whole have complained a number of times to the Area General Managers and the Project Officers regarding the widespread cracking of houses, but according to the villagers the MCL officials do not address their issues and express their helplessness in this regard. A few officials have even threatened the villagers to leave the village instead of paying for the loss. Truck traffic makes varying noise levels. Haul trucks and loaders within the quarry are on the move continually during the day and night. Transport trucks arrive empty and are filled. Filling often results in loud crashes and thumps as empty metal bins are loaded. All trucks and mobile plants have loud and penetrating reversing beepers that are a constant nuisance to local residents.

Table 9: Causes of Noise Pollution Cause of noise pollution Frequency Percent

Cause of noise pollution	*Frequency*	*Percent*
Moving of heavy vehicle	42	9.3
Blasting	408	90.7
Total	450	100.0

Source: Field Study

Table 9 shows that around 91 per cent of the household reported blasting as the major cause of noise pollution and 9 per cent of the household replied the moving of heavy vehicles in the mining area

creates a noise pollution which was not found in the control villages. Due to the noise pollution, the households faced a lot of problems, i.e. hearing, mental disturbance, disturbance in students' study and house cracking which has been clearly shown in Table 10.

Table 10: Issues Associated with noise pollution

Problem faced due to noise pollution	*Frequency*	*Percent*
Hearing	23	5.1
Mental disturbance	58	12.89
Students' study disturbed	3	.7
House cracking	366	81.3
Total	450	100.0

Source: Field Study

Table 10 represents the data about problems faced by the mining affected households. Around 81.3 per cent of the households stated that due to blasting in the mining sites their houses have cracked and 13 per cent households specified that they have been suffering from mental disturbances. Noise pollution is one of the leading nuisances generated by the mining activities. The noise pollution occurs due to noise from the vehicles, bulldozers and excavators. But the central cause of noise pollution is the form of blasting using explosive material to get the rocks from mines. MCL authorities when contacted during field investigation replied that they are the trendsetters in introducing blast-free technology of mining coal in open cast mines by Surface Miner. However, it was evident that noise has serious implications for the workers working in the area in general and the local dwellers in particular. On the other hand, in the control villages more than 95 per cent of the households stated that neither is there noise pollution in their area nor is there any house which has undergone any sort of cracking. There is no movement of heavy vehicles in their villages.

So far as noise pollution is the concern; it is due to heavy machineries and blasting operations. So, workers in mines should be provided with hearing protection devices and the duration of exposure should be reduced to minimize the adverse health effects. It was noticed that the company is providing sufficient hearing protection materials (ear plugs and ear muffs) to operators and workers to reduce health hazards from noise. But it is seen that operators are not following the norms. Though officials from MCL said that the blasting time is very limited and its effect is minimized

by the use of electronic delay detonators, the villagers state that they suffer immensely due to blasting and it was also evident during fieldwork that most of the houses had cracks in their walls.

Impact on Local Biodiversity

The development of coal mines has led to the loss of forest cover and simultaneously affected biodiversity and wildlife corridors in these forest areas. According to the Ministry of Coal (MoC), about 60 per cent of coal resources are located in the forest areas (MoC, 2005). Most coal blocks allocated in the last few years have been in or adjoining forest areas. Of all the coal leases acquired by Coal India Limited (CIL), 28 per cent lay under forest region, i.e. out of about 2,00,000 ha of coal leases 55,000 ha lies under forest cover (Greenpeace Report 2012).

The MoC estimated that given the rising demand, the need for forest land for mining will increase from the about 22,000 ha in 2005 to about 75,000 ha by 2025. In Angul-Talcher region in Odisha, for instance, forest cover has reduced by 11 per cent between 1973 and 2007 due to coal mining (Singh 2010). Coal mining, especially open cast mining, and evacuation of coal requires large tracts of land for extraction processes, for industrial purposes like thermal power plants and captive plants, as well as for ancillary processes such as overburden dumps, pipelines, railway lines and public works. It has destroyed not only the standing forests but also animal corridors and has diverted the streams.

Mining has affected the local environment and associated biota through removal of vegetation and topsoil, displacement of fauna, release of pollutants, and generation of noise. Mining of coal, both at surface and subsurface levels, causes enormous damage to the flora, fauna, hydrological relations and soil biological properties. Destruction of forests during mining operation is invariably accompanied by an extensive damage and loss to the ecosystem. The overburden of coal mines when dumped in unmined areas creates mine spills which ultimately affects the surrounding vegetation.

The destruction of ecosystem in the post-mining period has brought a great loss to the wildlife and their habitat. Both directly and indirectly, it has damaged the wildlife. These animals live in communities that depend on each other. The survival of these species can depend on local ecosystem, soil conditions, local climate, altitude, and other features of the local habitat. The impacts stem primarily from disturbing, removing, and redistributing the land

surface. Some impacts are short-term and confined to the mine site; others may have far-reaching, long-term effects. The most direct effect on wildlife is destruction or displacement of species in areas of excavation and heaping of mine wastes. As per the villagers, many wildlife species are extinct. Mobile wildlife species, like game animals, birds, and predators have left these areas. More sedentary animals, like invertebrates, many reptiles, burrowing rodents, and small mammals are severely affected. The fragmentation of habitats due to mining activities has made it difficult for some animals to make an ecological move. In some cases the isolation has led to local decline of species, or genetic effects such as inbreeding. Species that require large patches of forest have simply disappeared.

Health Problems in Talcher Coalfield

The number of coal-associated activities, such as coal-processing chemicals, equipment powered by diesel engines, explosives, dust from uncovered coal trucks have caused a huge setback to the environmental conditions that has degraded the quality of air in the village. However, the air pollution in the post-mining period has not only degraded the environment but has also created panic and has given a big jolt to the health status of the villagers in the form of increased level of illness, infections, diseases, etc. The information garnered from the affected villages and number of evidences suggest that due to the impact of coal mining, there has been adverse health effect on villager's skin, eyes and occurrence of harmful diseases. Villagers are constantly being exposed to increasing levels of harmful air pollution, causing significant illnesses and leading to thousands of hospitalizations. An important study in the American Heart Association Journal Circulation in 2010 found that even short exposures to PM 2.5 μm in diameter (PM2.5) can trigger cardiovascular deaths and illness, while long-term exposure (i.e. over a few years) greatly increases the risk for cardiovascular mortality than shorter exposures reduces life expectancy among highly exposed groups by several months to a few years. In the study of the villages, it was found that dust particles borne through transportation and blasting has caused wide spread eye irritation and infections.

As the villagers are residing very close to the coal mines, they are exposed to the various components of air pollution. Inhaling of air pollutants are triggering asthma attacks, respiratory infections, or changes in lung function. The cases of suffering from asthma and respiratory toxicities are increasing due to lack of awareness

of people. Though MCL has organized lots of events to create awareness among villagers, they have not succeeded in educating the masses regarding the harsh impacts of air-borne diseases. When Sulphur dioxide is inhaled it irritates the lungs, triggering bronchial reactions and reducing lung function. The most measurable effects occur in children and in people with an already-compromised lung function. Other pollutants are absorbed and distributed in the body and may produce systemic effects or effects distant from the entry point of the lungs.

As a result, organs other than the lungs (e.g. the central nervous system, brain, heart, blood, liver and kidneys) are affected by air pollutants. Air pollution associated with the extraction, transportation and combustion of coal has caused ill health and deaths by contributing to the development of eye infections and several other diseases. The mining and transportation of coal has exposed the workers and local communities to dangerous coal dust, and diesel emissions from coal transport which has ill effects on the health condition of the villagers. Table 11 gives a clear picture of the health impact of coal mining in Talcher coalfield.

Table 11: Major health problems faced by households in Talcher Coalfield

Diseases	*Households affected in Mining Villages*	*Households affected in Control Villages*
Fever	63(14.93)	15 (45.45)
Gastric Disorders	180(42.65)	10(30.30)
Skin Diseases	73(17.29)	Nil
TB	9(2.13)	Nil
Eye allergy	34(8.05)	Nil
Asthma	22(5.21)	3 (9.09)
Arthritis	41(9.72)	5 (15.15)
Total Households suffer	422 (93.77%)	33 (22%)

Source: Field Study
Note: Figures in parentheses show the percentage of the respective health problems to total health problems in the mining and control villages.

Table 11 specifies that introduction of mining has brought a serious threat to the health of local communities. A total of 450 households were surveyed in the mining villages. Out of these households, 93.77 per cent households reveal that they have suffered from

some serious diseases in last three years. Among the diverse health problems, gastric disorder is the most prevalent one which accounts 42.65 per cent of the total health problems and this is because of the coal surrounding. The second major complaint is of skin diseases which accounts nearly 17.29 pe cent of the sample households. The major alarming situation is that around 2.13 per cent households are suffering from TB. Though the cases are more in number, it was not revealed by the concerned households. The adjacent coal belt was recorded as the region of highest temperature of Angul district. And this problem becomes very severe in summer. The district is considered as the hot spot of Odisha as it touches nearly 50^0 Celcius temperature during summer.

There are also other health problems like dehydration, cough and cold, asthma, etc. Though MCL is providing free medical facilities, these are restricted to employees and their family members. In this situation, poor households are the worst sufferers. They have neither a job nor do they have free medical facilities.

This depressing picture of health status in the mining villages is very much in contrast to that of control villages. In the total 150 households surveyed in the two control villages, only 22 per cent of the households complained that they have some health problems during the last three years. There is not even a single case of TB, skin disease and eye allergy in this area. So it is abundantly clear that the incidence of TB and skin diseases in the mining areas and its neighbourhoods is solely due to the mines and its pollutants, mainly coal dust. There are only a few cases of fever, gastric disorders and arthritis in this area, which is general in any village.

Cost of Ill Health

The cost of ill health includes direct and indirect medical costs which a household bears on behalf of health. While direct medical costs take account of the medical expenditure of a household such as a doctor's fee, medicines and laboratory tests, indirect medical cost refers to loss of work days due to ill health and income loss due to this (Bahl, et al 2004). In the present study, in order to calculate the total cost of illness, both direct and indirect costs were calculated.

The data collected from the field reveals that the introduction of the mining has not only created lots of diseases in mining affected villages but has also increased health expenditure. Table-12 displays the direct medical expenditure of mining village (before and after mining) and control village. This table clearly demonatrates that

Table 12: Direct medical expenditure (monthly)

Variables	*Values (in days/rupees)*
Pre-Mining Scenario	
$A_{1:}$ Average doctor visit in a month	1.05
$A_{2:}$ Average cost of doctor's fee	Rs 32.77
Cost for sample household = C_1: $A_1 \times A_2$	34.40
B_1: Possible case of taking medicine	1.10
B_2: Average expenditure on medicine	Rs. 37.27
Cost for sample household = C_2: $B_1 \times B_2$	Rs. 40.99
L_1: Probable laboratory test	1.10
L_2 : Average expenditure on laboratory test	Rs. 24.97
Cost for sample household = C_3: $L_1 \times L_2$	Rs. 27.46
Post-Mining Scenario	
$P_{1:}$ Average doctor visit in a month	2.81
$P_{2:}$ Average cost of doctor's fee	Rs. 131.58
Cost for sample household = T_1: $P_1 \times P_2$	369.73
S_1: Possible case of taking medicine	3.00
S_2: Average expenditure on medicine	Rs. 477.33
Cost for sample household = T_2: $S_1 \times S_2$	Rs. 1431.99
M_1: Probable laboratory test	1.46
M_2 : Average expenditure on laboratory test	Rs. 97.56
Cost for sample household = T_3: $M_1 \times M_2$	Rs. 142.43
Control Village Scenario	
$M_{1:}$ Probable doctor visit in a month	1.00
$M_{2:}$ Average cost of doctor's fee	Rs. 52.27
Cost for sample household = G_1: $M_1 \times M_2$	52.27
D_1: Possible case of taking medicine	1.00
D_2: Average expenditure on medicine	Rs. 44.11
Cost for sample household = G_2: $D_1 \times D_2$	Rs. 44.11
N_1: Probable laboratory test	1.00
N_2 : Average expenditure on laboratory test	Rs. 20.52
Cost for sample household = G_3: $N_1 \times N_2$	Rs. 20.52

Source: Field Study

due to mining the direct cost of medical expenditure has increased as compared to pre-mining and control villages. After mining, most of the villagers reported that they are getting affected by a lot of diseases which was not the case prior to mining. In the context of control villages, their medical expenditure is as usual but rises slightly as compared to the mining villages. It was discovered that average expense for visits to the doctor, the doctor's fee, the average cost of medicine and average cost of laboratory test are much more in the mining affected villages than the pre-mining and control villages. The residents of mining affected villages revealed that they used to spend less much before the intrusion of mining activities. The only reason for this is that mining has brought in tremendous changes in the local area which in turn produced major grounds for air, water and noise pollution. But it was not found in the control villages. During field visit to the control villages, 75 per cent households reported that they are spending less money on medical overheads in a year (Table 12).

Women and children do not constitute the major work force in the mining affected villages but they are the most vulnerable section of this region. More than 51 per cent of the villagers claimed that frequency of women and children getting stuck with various diseases have increased enormously than the pre-mining phase. Due to constant exposure of dust particles they are more prone to the diseases like skin infections and also experiencing malfunctioning of various sensory organs, which has a long-term impact on their reproductive health. Dust pollution and blasting have tremendous effects on pregnant women. But the condition is worst for a non-employee of MCL. Because of economic reasons, women of this category have no choice but to expose themselves and their children to severe health risks, which not only threatens their lives, but also that of the foetus. According to the villagers, the frequency of diseases also increased manifold i.e. tuberculosis, cough and cold, malaria, skin diseases, diarrhoea, staining of teeth, joints pain, arthritis, lethargy are now frequently occurring diseases in the mining affected villages.

Indirect Cost of Ill-Health

As it was discussed before, indirect medical cost comprises the loss of work days and income loss due to this. During field study, the households reported that due to ill health, they are losing their work days and income significantly. Table 13 describes the indirect cost of ill-health.

Table 13: Indirect Medical Cost (Monthly)

Variables	*Values (in days/rupees)*
Pre Mining Scenario	
D: Total number of work days lost in a month	377
W: Average daily wage rate	Rs 103.42
W_1: Wage loss per household = W × D/Total Sample	Rs 86.64
Post Mining Scenario	
D_2: Total number of work days lost in a month	2008
F: Average daily wage rate	Rs 240.29
W_2: Wage loss per household = F × D_2/(Total Sample)	Rs 1072.22
Control Village Scenario	
D_3: Total number of work days lost in a month	148
J: Average daily wage rate	Rs 188.21
W_3: Wage loss per household = J × D_4/(Total Sample)	Rs 185.70

Source: Field Study

Table 13 provides an entire gamut of indirect medical costs which the residents of Anugul-Talcher belt bear regularly. During the pre-mining period, the 450 households together lost 377 work days in a month. However, in the post-mining phase the same number of households lost 2008 work days in a month which indicates that mining has a huge negative impact on the health condition of the respondents. At the same time, the indirect cost of control villages is comparatively low. Since the respondents of control villages are not affected by industrial activity, their indirect medical cost is only 185.70 rupees.

Total Cost of Ill-Health

The total cost of ill health is the addition of all the aspects i.e. direct and indirect medical costs. So the total cost of health hazards per household is as follows:

1. **Total Cost per Household (Pre-Mining):**
   $TC_1 = C_1+C_2+C_3+W_1$
   $TC_1 = 34.40+40.99+27.46+86.64$
   TC_1 = Rs 189.49

2. **Total Cost per Household (Post-Mining):**
   $TC_2 = T_1+T_2+T_3+W_2$
   $TC_2 = 369.73+1431.99+142.43+1072.22$
   $TC_2 = Rs\ 3016.37$

3. **Total Cost per Household (Control Village):**
   $TC_3 = G_1+G_2+G_3+W_3$
   $TC_3 = 52.27+44.11+20.52+185.70$
   $TC_3 = Rs\ 302.6$

From these statisitcs, it is clear that the total cost of illness is high among the respondents of mining affected villages. However, the average direct medical cost of pre-mining villages is reasonably less in contrast to the post-mining villages. The average total medical cost of illness is also high (3016.37 rupees) among the respondents of mining affected villages in comparison to the pre-mining (189.49 rupees) and control villages (302.6 rupees). Henceforth, it can be concluded that the total cost of illness is severely high among the residents of mining affected villages.

It is not that MCL authorities are not aware about this and they are not taking any action to save these people from the health risk, but unfortunately there is a lack of proper implementation of the health-related policies of MCL. The worst sufferers are the women in the mining regions, whose health issues in general are only marginally addressed in the country. India's development policies, especially in the context of economic activities like mining, do not take into account women's and children's health as important indices for human growth and development. At present, the occupation of the villagers is primarily non-agriculture which has alienated the women from their traditional way of food security, rights over natural resources and of course steered impediment to their health status. In this situation how government agencies, policy makers and civil society groups define and implement policies of development as well as human growth vis-à-vis economic programmes from a gender perspective, especially in the health sector, is a matter of concern both for the MCL and the statutory government.

Villagers, who are inclined to consume locally-grown products and locally-caught fish, may also receive higher than average exposure to deposited pollutants if they live close to a facility. In addition, some pollutants are transported in the atmosphere and deposited far away from the source. For instance, sulphur dioxide is transformed in the atmosphere to sulphuric acid and sulphates, which can deposited

up to 1000 miles from the source. Mercury can travel even further. Children and women living in the vicinity of open cast mines have the highest health risks. Adults are also experiencing some discrepancies by inhaling dust from the nearby mining regions. Furthermore, these people are exposed to numerous other air pollutants emitted from the mines associated with smokestacks and air pollution from other sources such as combustion of coal. Mineworkers and their families also often reside in the communities where coal is being mined. Some of the additional health risks and dangers to residents of coal mining communities include injuries and fatalities related to the collapse of high walls, roads and homes adjacent to or above coal seams being mined; the blasting of fly rock offsite onto a homeowner's land or public roadway; injury and/or suffocation at abandoned mine sites; and the inhalation of airborne fine dust particles off-site.

There are serious health risks from exposure to air pollution in the affected villages as the villagers are continuously being exposed to pollutants for a long duration which may lead to serious casualties in the coming days. The Talcher-Angul coal belt was reportedly considered as the highest temperature zone mostly during summer. This belt of Odisha is considered as one of the hottest places in the state and during summer, the temperature climbs up to 47-48 degree Celcius. Not only are the employees facing several health issues but several non-employees of MCL have reported that they are also suffering from diseases like skin infections, respiratory diseases, asthma, TB, etc. As they are not employees of MCL, they are not provided with treatment facilities in the MCL hospitals. Therefore, a huge part of their income goes for the treatment of health problems associated with coal mining. Some villagers are demanding that MCL should have a policy that could provide at least 70 per cent of the medical expenses for a non-employee.

Abandoned Mining and Associated Health Problems

The continuous coal mining exploration near Jambu Bahali village and near Anantpur mines has not only given rise to the environmental issues but has also developed various unhealthy challenges. During field investigation it was found that rubbish depositories have accumulated, with no treatment and maintenance, and has become a menace to the villages. Abandoned mines have become dumping yards and have resulted in safe breeding grounds for mosquitoes in the study areas.

The residents of mining-affected villages also reported that

abandoned mines are costing them their livestock, with the animal deaths still increasing. It is also that villagers are not aware of the dangers associated with abandoned mining and while they are going for coal collection or taking bath in the nearby quarries, unknowingly they are becoming the victims of abandoned mines, just as many cows and goats have fallen in the abandoned mines and have died. Deaths related to abandoned mining could have been prevented by creating awareness, sign boards near those mines but the inappropriate policies of the government and gross negligence of MCL has created havoc for the villagers. Moreover, the villagers claimed that abandoned mines are full of hazards, everything from snakes to explosives, with rotten timbers and crumbling shafts that living beings can fall into. The mines are so dark that if anything falls in it nothing can be seen. There were many incidences of people and animals being trapped in the mines and incurring fatal injuries. Therefore, it is obvious that that there are a number of health issues which have emerged due to abandoned sites of mining, but the lack of seriousness of the MCL authorities and the state administration has resulted in them being sources of great distress for the villagers.

Other Health Issues

As we all are aware that mining operations require large amount of water, the repercussions associated with it cannot be ignored. The condition of water in the mining areas of Talchar has worsened because of the large amount of coal wastes that have contaminated the water resources in and around the villages. Villagers reported that the surface and ground water bodies have been polluted continuously for year, making the water unfit for cultivation and resulting in a number of health problems among the villagers. Water contamination due to the mining activities has a long-term effect and lasts longer than the short-term economic gain from the mining. The villagers who are living in the mining areas have no choice and are forced to use the contaminated water both for domestic and bathing/washing purposes. More than 75 per cent of the villagers claimed that incidence of diarrhoea and dysentery have become common among the villagers. The most affected section of the people are the women. It is women who go to collect water and have direct contact with water sources for performing household chores such as washing clothes, bathing children and collecting water. A few learned villagers complained that certain harmful metals have polluted the water which the villagers are unaware of and which has

resulted in skin irritation, respiratory tract problems, nasal ulcers, pneumonia, etc. A few children in the villages were also seen with white sores and white marks all over the body. The local people complained of having frequent incidences of vomiting, eosinophilia and diarrhoea. MCL boasts of treatment plants for water but the situation in the villages is otherwise. The taste of the water has totally changed. Villagers have no other alternative but to drink the water which is available to them and they complain of foulness in taste and colour. During the field studies, it was also observed that waste from the top of the coal heap were seen falling in the pond which was located beneath and cows and dogs were seen drinking the same water from the pond, which is the only source of bathing and washing utensils in the village Balunga Khamar.

Most of the women in the mining villages complained that they are not getting adequate water to drink and some of them also stated that they have to remain without taking bath for four to five days as the pond which was earlier used for bathing purpose is either covered with dust or has dried up. The number of sources of water has also decreased due to the ill effect of mining. This is the common situation in all the mining-affected villages, especially in summer. No doubt MCL is providing water, but that is not adequate to meet all the water needs. The clothes of children as well as elders were seen unclean and filthy. Children have the highest probability of getting affected in coming days if appropriate policy is not formulated for their betterment. Water pollution and shortage which has led to ill health has also resulted in mental illness as women have to wait for the tankers to provide them water whose frequency and timing is absolutely unpredictable. Therefore, it is directly linked with the mental tension of the women folk more particularly as they have to look after the household affairs, including children.

When a comparative analysis is done between the pre-mining and the post-mining period it is clearly visible that displacement of the villagers has brought a big transition in the quality of life of the villagers especially from the point of view of health. In the pre-mining period when the villagers had full access to forest, agriculture, CPR, etc. their health and nutrition status was better as compared to the present scenario. The diversity of crops which were grown by the villagers earlier as well as the forest products such as roots, fruits, traditional herbs provided balanced nutrition to the villagers.

At present, even when all the forest land is being used in the public interest, there has been deterioration in the health status of men, women and children. Prior to mining the only source of medicine for

the villagers was the forest herbs and aromatic plants, but after the inception of mining, they have no access to the traditional medicine and have to depend purely on the prescribed medicines of the doctors. Even now they suffer from various diseases which they had never heard about. Medical services and medicine now are available in the medical stores but they cost a lot and the plight of a non-employee of MCL in this regard is very distressing. The doctors at the hospitals openly expressed the opinion that the primary reason for the poor health status and diseases of the villagers is mining. The frequency of the diseases occurring in both the experimental and control villages are described in the following table.

Table-14 reveals that some of the diseases which were confined to very limited populations and infrequent occurrences in the pre-mining periods have spread to a majority of the population in the post-mining period. The frequencies of occurrence of diseases have also increased. Gastro intestinal disease has become a very prominent disease in mining-affected villages; only 1 per cent households said that they had suffered from such ailments on a daily basis before mining activities. Even in case of controlled village, the situation is more or less similar to the pre-mining period (3.33%). Fever and asthma has become very common diseases in the post-mining period.

The two control villages exhibited different results. Villagers were seen happy with the condition of water they were getting and almost all the household reported that the taste of water has not changed nor are they experiencing any water-borne diseases. Women and children were seen in the control villages having good health and there were no patches or marks found on the body of children which was rampant in the mining areas. Water bodies were observed to be in good condition and absolutely free from impurities such as dust or any kind of lethal waste which was found in the mining affected villages.

Conclusion

Environmental degradation is inevitable while it is associated with developmental activities such as coal mining. In the present study, it was observed that in comparison to control villages, the mining-affected villages witnessed varied environmental issues. With increased production of coal, the environment of mining-affected villages is degrading at a fast pace. Though the mining authorities claimed that they have taken varied precautionary measures to control the level of pollution, it still is responsible for air, water

Table-14: Frequency of occurrence of diseases in study areas

Frequency	*Mining villages*										*Control villages*				
	Daily		*Weekly*		*Monthly*		*Yearly*		*Total*		*Daily*	*Weekly*	*Monthly*	*Yearly*	*Total*
Diseases	*B*	*A*	*B*	*A*	*B*	*A*	*B*	*A*	*B*	*A*					
Arthritis	4	29	1	38	10	71	5	10			……	……	1	…..	1
Asthma	15	40	5	27	7	55	40	50					10	2	12
Gastro intestinal disease	5	137	15	61	7	36	5	10			5	1	11		17
Skin disease	5	48	7	22	10	60	30	72			…..	……	……	3	3
TB		7		2	2	3	2	6			…..	….	…..	1	1
Fever		2		1	3	98	130	237			…..	…..	22	81	103

Source: Field Work

and noise related pollutions. With the concentration of SPM and RSPM in some areas going beyond permissible limits, this ultimately is responsible for numerous respiratory diseases. It has actually decreased the average life span of project affected persons. Similarly, the ground water quality in Talcher-Anugal industrial complex has crossed more than 100 which is not at all suitable for drinking. The rise of suspended sediments, COD in most of the mining areas and BOD in a few cases has crossed the specified standard in mining drainage water. This may disturb the aquatic life in local areas. The ill-effects of noise pollution is not only raising the household repairing costs but is also responsible for different sorts of hearing as well as mental disturbances. From the existing air, water and noise quality data, personal observation, interactions and through photographic collection of the study area, it can be concluded that a major initiation is required to control the environmental degradation by minimizing several aspects of pollution.

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