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An Evaluation of the human health and agricultural impacts of informal coal mining in Jaintia Hills of Meghalaya

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Abstract-

Many tribal communities especially the poor rural households in the underdeveloped and developing countries depend directly on endowed natural resources for their cash livelihoods. The Jaintia Hills district of Meghalaya is a unique region comprising of aboriginal tribes with a matrilineal society is also a major coal producing area. The present paper attempts to study the artisanal mine workers as they do not hesitate to do work even under adverse climatic or working conditions which are largely operated in remote interior areas. This paper also focused on mining of coal in the region where land is used primarily for agricultural cultivation. Method of household surveys was employed in the study. A total of 180 households were surveyed following a simple random sampling method and where ever possible a visit to the coal quarries was made which was based on the larger number of coal workers at the mining sites. Chi square was employed as the statistical technique for the present study. It was observed that with the starting of mining operation occupational diseases or accidents of coal workers and their family members has been ignored due to the stigma of illegality. Agricultural production has decreased over the years due to scarcity of agricultural labourer around mining region with 52.2 % of the local households have focussed on coal activities. Coal mining work in Jaintia Hills is an additional source of income to the rural population and migrants or the so-called socio-economically marginalised groups.

Keywords: Informal coal mining; health conditions; agriculture; Jaintia Hills; Meghalaya.

1. Introduction

Artisanal and small scale mining (ASM) is practised in different kinds of rural and urban economies of the world and it has evolved as another major economic activity next to agricultural sector since ancient times. In the present world scenario India holds third as the largest coal producer however artisanal mines and the process of acquiring or mining of minerals are a section of informal sector in India. It was estimated globally in 2017 about 40.5 million people were part of the ASM workforce of which there is a significant increase from 30 million in 2014 (Fritz et al., 2017). Indigenous communities are largely involved in mining extraction of coal deposits on a small scale which are often located in less accessible places. The artisanal miners working in the unsafe mines put their own lives at risk for the sake of earning a livelihood and to enhance their family's income (Deb et al., 2004). In order to prosper mining activities are combined together with other economic activities like agriculture as mining is a seasonal activity. An accepted definition of ASM particularly in Indian context includes any mining excavation that produces up to a maximum capacity of 50,000 tonnes annually (Ghose, 2003a). Since the construction of the National Highway 44 in 1978 along the Shillong-Jowai Badarpur road commercial exploitation of prominent coal resources in Jaintia Hills took place. Out of the total labour force, more than 50% miners in India can be employed in informal mines (Ghose and Roy, 2007). In India use of minerals was known since the Indus Valley Civilization and mining of coal was first established by Sumner and Heatly officer in charge of the British East India Company in Raniganj coalfield in the year 1774 (Tandon, 1990).

1.1 Mining methods in informal coal mines of Jaintia Hills

ASM refers to the use of manual labour for the extraction of mineral deposits. More precisely often mine workers use simple hand tools like shovels, chisels, pick axes, hammers or spades for digging out coal of underground pits. The coal workers put their health and lives at high risk by sliding down the precarious bamboo ladders into the deep and dark coal pits without the use of safety head gear. While chipping out coal only a torch was used to illuminate the narrow rat holes. Most of the known coal resources occurred in the eastern parts of Jaintia Hills. The indigenous peoples claimed that by their own customs or as conferred to them by the Sixth Scheduled of India have mineral rights to own the mineral resources that lie underneath their land. Coal shafts are punctured below the ground ranging from a depth of 50-350 feet and then miners make narrow adits of 1000-2000 metres in order to reach the coal seam. Even though mine owners operate these mining business illegally yet they manage to reap large profits, however sadly true miners

have to labour hard and because of the tedious task in mines they were not able to earn fair wages. The commercial mining of coal in Meghalaya began in Khasi Hills at Cherra ponjee village in the 19th century and later on coal deposits were also discovered in Jaintia and Garo Hills at the start of 1970s (Directorate of Mineral Resources 1992). It was estimated by local mine owners that a large number of active mines is into the 1000's and rat hole mining which is widely practised in Jaintia Hills produces coal at the rate of 2 million tons per year (Kilsby 2010). Coal is largely transported across borders of neighbouring countries in international markets such as Bangladesh and Nepal.

1.2 Significance of the study

ASM are important in Meghalaya because together these informal mines generate direct employment to a large number of people especially for lower income communities. Therefore unemployed sections including youngsters from the rural areas having no social securities are then forced to seek work in the mines for daily sustenance so as to financially support their family members.

1.3 Statement of Problem

In Meghalaya informal coal mines offers employment to complement low income and it promotes wealth creation to the local communities but due to the unorganised mining it posed multiple problems that affects the productivity of mine workers. Safety at work place for the workers is not taken as top priority by the respective coal owner. While working in the coal mines of Jaintia Hills workers stated they are not provided with potable drinking water supply, protective clothing, nor separate toilet spaces for male and female workers. As such there is a conspicuous absence of safety measures at the mine sites. For every unit of coal produced is at the steep cost to the health of workers. Small mines are characterized by low capital investment hence coal exploration or its extraction is not carried out by expert geologists. This resulted in frequent mine accidents and massive environmental degradation. When occupational related injuries or accidents occurred no monetary compensation is provided for medical treatment to the workers thereby all medical expenses come out of their own pockets. Ultimately these lead to physical stress as well as psychological distress among miners including poor work performance. About 80 countries of the world practised ASM and continued work without the use of modern technologies. One of the glaring problems of informal mining sector is the common prevalence of gender discrimination. Wage differential often exist in the same mine where women workers were paid lesser when compared to their male counterparts for equally long working hours. There is no limitation that specified the number of working hours and

no regulation of employment of child labour in hazardous work. Most of the workers prefer to work longer hours in the mines with the intention to maximise earnings. The high price of essential food items in mining communities severely affects miner's household budget and also food consumption pattern. In Meghalaya after the National Green Tribunal ban on coal extraction since April 2014 many of the artisanal miners in rural areas are rendered jobless leading them to lose their livelihoods and brought economic hardships.

1.4 Objectives of the study:

The specific objectives of the research study include:

1. To study the working and living conditions of coal mine workers in coal mines.
2. To examine the impact of mining activities as a source of rural livelihoods on the health of coal workers and mining households.
3. To examine the impact of the number of years at work place has on health status of coal workers.

1.5 Hypotheses of the study:

The following hypotheses are developed for the research study:

1. It is expected that there would be significant impact of mining activities on working and living conditions of coal workers.
2. It is expected that there would be a common health problems among coal workers and mining households as a result of mining activities.
3. It is expected that there would be significant impact of the number of years at work place on the health status of coal workers.
4. It is expected that there would be significant impact of extensive coal extraction on agricultural productivity.

2. Review of Literature

Rai 2002 has presented that extensive coal extraction in Jaintia Hills has harmful impacts on the surrounding environment. He investigated how coal operation degrades the local environment, the prevalence of shortage of drinking water, loss of forest cover, contamination of nearby rivers and streams, increase in degraded land, land subsidence and problems of coal dust. All these arise due to the adoption of unscientific mining methods and small scale operation in the region.

Singh and Swer 2004 have highlighted the factual ill effects of underground coal mining on the quality and availability of water resources. They attributed the degradation of water quality to the unscientific practices to dig out coal in Jaintia Hills. They also indicated the discharge of acid mine drainage into the nearby water bodies further contaminate its quality resulting to an environment devoid of aquatic life. The untreated acid mine discharge renders water unfit for agricultural and domestic purposes.

B Blahwar et al 2012 have observed that coals excavated were interspersed with forest area, agricultural fields and grasslands. They indicated once coal are exhausted post mining measures of backfilling the mines were not followed which degrades the local environment and poses a serious threat to human life and livestock. With the passage of time mine shaft get submerged and it is not visible to people as it stay hidden due to overgrown vegetation. A total of 1281 rat hole mines were identified in the studied watershed. The mine shaft generally ranges from 3-6 m wide. Coal depots are also responsible for water pollution. Large scale mining activities have exacerbated the issue of acid rock drainage ARD in the region. Rimanar River has changed the colour to orange yellow due to presence of iron precipitates.

Adu Yeboah et al 2008 have cited the socio-economic consequence of mining on the communities is the rising cost of living. The cost of essentials available at the mine sites like food, water, accommodation etc makes it difficult for workers to purchase due to high prices.

Akabzaa and Darimani 2001 have outlined that miners at work area are relatively at high risk of occupational diseases. The top ten occupational diseases suffered by workers include malaria, diarrhoea, upper respiratory diseases, skin diseases, acute conjunctivitis and accidents. About 199 and 109 cases of pneumonia and pulmonary tuberculosis which are the symptoms of upper respiratory tract infections are reported annually indicating relatively high occurrence.

Rachael Kilsby 2010 has reported more than 70% of the land in Jaintia Hills is used for illegal coal mining which often take place in the absence of State government regulation. Many of the Nepalese women are seen to engage in petty jobs like selling wine, shop keeping, cooking and coal breaking nearby the mining areas. Children may sometimes accompany their mothers to the mines, working as part of the family unit and thus generating earnings on a daily basis for the family. The prevalence of child labour is also widespread in these mines working without the protection of any legal laws.

Lahiri-Dutt 2003 has outlined around 30,000 coal workers of Meghalaya fall under the category of 'non-legal' space. A large number of workers in the collieries of North eastern India are from Nepal. She gave a description of how living and working conditions are deplorable and workers tend to construct temporary huts covered with plastic sheets for shelter. The mining households living near the mine sites usually have less access to potable drinking water supply, no electricity, no health services and no educational institutions were provided by their mine owners. She also observed most of the women workers belong to minority communities; they perform work manually and engaged themselves in risky jobs without the use of any safety measures. The existence of pay gap between male and female mine workers exist in the collieries.

3. Profile of study area

Jaintia Hills is located in between east Longitude $91^0 54^{"}$ and $92^0 45$" and between north Latitudes $24^0 58$' and $25^0 45$'. The region lies in the eastern part of Meghalaya and has a geographical area of 3819 sq.km. It is surrounded by the State of Assam in the north and the east, Bangladesh in the south, and East Khasi Hills district in the west. Jaintia Hills is sub-divided into two districts - West Jaintia Hills and East Jaintia Hills. It is demarcated into five developmental blocks namely Thadlaskein, Amlarem, Laskein, Khliehriat and Saipung. As per 2001 Census the population in Jaintia Hills was 299,108 of which male population comprised 149,891 and female population was 149,217. As per 2011 Census, Jaintia Hills ranks fifth in terms of density of population with 103 people residing per square kilometre which is lesser than the State average of 132. In terms of sex ratio it has 1013 females per 1000 males which are higher than the State average of 989. In respect of education the District has been reckoned as the lowest literate district with a rate of 61.6% in comparison to other districts of Meghalaya. In terms of health the region reports poor health infrastructure. Most of the rural households prefer to visit CHCs and PHCs as the State government hospitals are not properly equipped and insufficient number of staff workers to deliver the required health care services.

4. Methodology

This research work used both quantitative and qualitative methods. Primary data has been collected to obtain information on health and livelihood conditions of coal workers. The study is also based on secondary data which was collected from different government offices and newspapers. Household survey was conducted in the prominent mining areas and a total of 180 households were surveyed randomly during 2016-2018. The sample consisted of 550 household members out of which 263 respondents were found to be working in the informal coal mines. Using stratified random technique data were collected from different coal mines of West and East Jaintia Hill districts. Statistical Package of Social Sciences SPSS was employed for data analysis and interpretation. For testing of hypotheses chi-square tests have been considered in the present study.

5. Data Analysis and Interpretation

Test of Hypotheses

Hypothesis 1: It is expected that there would be significant impact of mining activities on working and living conditions of coal workers.

In order to test the above supposition or hypothesis, chi-square test was employed and the result of the test is shown in Table 1.

Daily income * Structure of house Cross tabulation

Count

		Structure of house				Total
		Katcha	Semi-pucca	Pucca	Plastic house	
Daily Income	Rs 100-300	1	5	1	3	10
	Rs 301-500	33	22	18	35	108
	Rs 501-1000	18	9	10	3	40
	Above Rs 1000	7	3	3	9	22
Total		59	39	32	50	180

(**Source:** Calculated value)

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	17.970[a]	9	.036
Likelihood Ratio	19.652	9	.020
Linear-by-Linear Association	.638	1	.424
N of Valid Cases	180		

6 cells (37.5%) have expected count less than 5. The minimum expected count is 1.78.

Table 1 represents the daily income of the workers engaged in coal mining activities. Daily income of the coal workers is divided into four categories: income in the range of Rs 100-300, Rs 301-500, Rs 501-1000 and above Rs 1000 per day. It can be observed from Table 1 that 33 of the mining households who are earning between Rs 301-500 per day are staying in Katcha house while 35 of the surveyed households in the same earning group are staying in plastic house. The calculated chi-square value = 17.97. From the result of Table 1, the relationship between daily income and structure of house is found to be statistically significant as the chi-square value = 17.97 and p-value = .03 which is lesser than 0.05. Therefore null hypothesis is rejected and alternative hypothesis is accepted. It means as income increases fewer of the mining households stayed in propped up tarpaulin house. Accordingly we concluded that mining activities have significant impact on living conditions of coal workers.

Hypothesis 2: It is expected that there would be a common health problems among coal workers and mining households as a result of mining activities.

In order to test the above supposition or hypothesis, chi-square test was employed and the result of the test is shown in Table 2.

DAILY INCOME * Mining disease Crosstabulation

Count

		Mining disease								
		None	Malaria	Cholera	Tuberculosis	Skin disease	Vision defects	Respiratory problem	More than 1 disease	Total
Daily Income	100-300	0	1	0	0	1	0	1	7	10
	301-500	0	3	4	3	0	0	3	95	108
	501-1000	1	1	0	1	0	0	0	37	40
	Above 1000	0	0	0	0	0	1	0	21	22
Total		1	5	4	4	1	1	4	160	180

(**Source:** Calculated value)

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	38.551[a]	21	.011
Likelihood Ratio	25.958	21	.208
Linear-by-Linear Association	2.175	1	.140
N of Valid Cases	180		

a. 28 cells (87.5%) have expected count less than 5. The minimum expected count is .06.

Table 2 shows the daily income of coal workers and the different symptoms of occupational diseases. The table clearly indicates that 95 of the mining households out of

the 180 surveyed households who also belonged to the earning groups of Rs 301-500 are susceptible to suffer more than one disease at a time. These earning groups are mostly coal diggers who usually worked underground. From the outcome of the chi-square test as shown in Table 2 the relationship between daily income and mining diseases is found to be statistically significant as the chi-square value = 38.55 and p-value = .01 which is lesser than 0.05. Therefore null hypothesis is rejected and alternative hypothesis is accepted. Accordingly we concluded that due to mining activities it has resulted in the occurrence of common health problems among coal workers and mining households.

Job categories * lower acute Cross tabulation

Count

		Lower acute							
		none	persistent cough with mucus	pneumonia	chest congestion	chest pain while breathing	asthma	more than 1 disease	Total
Job categories	coal digger	16	1	0	3	2	1	153	176
	coal cutter	1	0	0	0	0	0	10	11
	coal - breaker	26	1	2	3	0	1	14	47
	coal owner	0	0	0	0	0	0	3	3
	mechanic	3	0	0	0	0	0	1	4
	coal sordar	5	0	0	1	1	0	15	22
	student	148	3	2	0	0	0	11	164
	unemployed	40	0	2	1	0	0	2	45
	non-miner	71	2	0	1	0	2	2	78
Total		310	7	6	9	3	4	211	550

(**Source:** Calculated value)

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	389.309[a]	48	.000
Likelihood Ratio	438.625	48	.000
Linear-by-Linear Association	297.117	1	.000
N of Valid Cases	550		

a. 50 cells (79.4%) have expected count less than 5. The minimum expected count is .02.

Table 3 shows the different categories of coal occupation and symptoms of Lower Acute Respiratory (LAR) illness. The result shows that 153 respondents who are engaged as coal digger suffered more than one disease at a time. On the other hand 148 respondents among the household members who are students do not suffer from LAR illness. The outcome of chi-square test shows that the relation between occupational categories and LAR illness is found to be statistically significant as the chi-square value = 389.30 and p-value = .000 which is lesser than 0.05. Therefore null hypothesis is rejected and alternative hypothesis is accepted. Accordingly we concluded that coal extraction has significant impact on health of mine workers and households proximate to the mines.

Hypothesis 3: It is expected that there would be significant impact of the number of years at work place on the health status of coal workers.

Chi-square test was performed to determine the significant relation between number of years at mine sites and health status of mine workers.

Duration of work * UAR Illness Cross tabulation

Count

		UAR Illness						
		none	sinusitis	ear aches	headache	fatigue	more than 1 disease	Total
Duration of work	10 days- 2 years	4	0	0	0	2	29	35
	3 years- 5 years	14	0	0	3	0	49	66
	6 years- 10 years	18	0	0	0	0	85	103
	Above 11 years	6	0	0	0	1	52	59
	Non-miner	220	1	1	3	0	62	287
Total		262	1	1	6	3	277	550

(**Source:** Calculated value)

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	239.177[a]	20	.000
Likelihood Ratio	247.281	20	.000
Linear-by-Linear Association	147.727	1	.000
N of Valid Cases	550		

a. 20 cells (66.7%) have expected count less than 5. The minimum expected count is .06.

Table 4 shows the duration of work of coal workers and different symptoms of Upper Acute Respiratory (UAR) illness. The table clearly reveals around 220 respondents among the household members who do not engaged in any kinds of coal occupation do not suffer from UAR illness. However 85 respondents who have been working between the ranges of 6 years to 10 years are suffering more than one disease at a time. The chi-square test is found to be statistically significant as the chi-square value = 239.17 and p-value = .000 which is lesser than 0.05. Therefore null hypothesis is rejected and alternative hypothesis is accepted. Accordingly we concluded that the longer the mine workers continue working at the coal mines the higher the chances to contract UAR illness. Therefore, there is significant relationship between duration of work and UAR illness.

Hypothesis 4: It is expected that there would be significant impact of extensive coal extraction on agricultural productivity.

In order to test the above supposition or hypothesis, chi-square test was conducted and the result of the test is shown in Table 5.

Underground depth in feet * Agricultural production Cross tabulation

Count

		Agricultural production			
		Increased	Decreased	Did not change	Total
Underground depth in feet	50-70 feet (shallow underground)	0	9	9	18
	71-120 feet (deep underground)	0	53	14	67
	Above 121 feet (very deep underground)	2	88	5	95
Total		2	150	28	180

(**Source:** Calculated value)

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	26.745[a]	4	.000
Likelihood Ratio	24.902	4	.000
Linear-by-Linear Association	24.976	1	.000
N of Valid Cases	180		

a. 4 cells (44.4%) have expected count less than 5. The minimum expected count is .20.

Table 5 shows underground depth of the coal mines which is classified as shallow underground (50-70 feet), deep underground (71-120 feet), and very deep underground (above 121 feet). The table clearly indicates about 88 of the surveyed households have stated that agricultural production has decreased in last 5 years due to land subsidence and cracks of very deep underground coal mines. Chi-square test is found to be statistically significant as the chi-square value = 26.74 and p-value = .000 which is lesser than 0.05. Therefore null hypothesis is rejected and alternative hypothesis is accepted. Accordingly we concluded that there is a significant difference between underground depth and agricultural production.

6. Conditions of work and living conditions of mining communities in Jaintia Hills colliery

A grandma from one of the coal mining town of Bapung narrated that her nearby private well which has been a source of drinking water for decades is no longer safe for human consumption. At present, if the same water is used for cooking rice, the colour of rice turns into blackish when cooked. Surprisingly some of the mining households undertake mining operations just behind their house which is supposed to be outdoor compound. The deplorable road condition which passes through the heart of the community is such that local residents used to sprinkle water on road every evening to reduce the dusty environment. Due to the frequent plying of overloaded coal trucks road gets dilapidated easily therefore making of left or right turn when needed is not possible. This in turn leads to serious accidents. At the time of box cutting or blasting of rocks overlying the coal seams, radioactive elements is present and when miners are exposed to such residues they constantly complained of the intense heat in the form of humid air which causes burning sensation to human skin. Even at a distance kilometre from mining sites the local passersby have to cover the nose and mouth to avoid inhaling of coal particles. At work place miners do not wear proper clothes, in fact they wore only short pant as it is too hot inside the rat hole but when one came out of the coal pit they have to cover themselves in spite of extreme heat to prevent from suffering of malaria and fever. The newly arrived workers were warned not to smoke, use candles or neither to fart inside the mines as it may causes discomfort to other co-workers. In terms of cooking some workers prefer outside in the open air. For dwelling they make temporary shed near the mines. During the weekend workers would play carom board which were actually a form of gambling to get rid of the monotonous life. As per calculations of the Impulse Social Enterprise indicated 10,000 to 15,000 people lost their lives in the informal coal mines of Meghalaya from 2007 up to

2014. Following the mine mishap which also leads to the death of 15 miners on 13 December 2018 at Ksan mine in Jaintia Hills of Meghalaya this throws light on the hazardous work conditions of coal workers.

7. Conclusion

The coal mining sector in Jaintia Hills is a private establishment and if the coal owners are obliged by labour laws to provide for various accommodation facilities in particular like protective gear and first aid facilities or services to mine workers as health and safety is of prime importance not only to the workers but his families as well. Villages endowed with rich mineral deposits basically drawn huge monetary benefits due to mining business where it should be the collective responsibility of government and non-government organisations to work together creating awareness that there may be other sources of livelihood but there is no alternatives to life. The State government has a leading role in implementing and regulating mining policies functioning in line with regional development, clean and safe environment, safety and security at work place, minimal disposal of waste. No doubt informal mining activities promote sustainable development by generating employment to rural poor and migrants, earn revenues for the State government. Reclamation of abandoned coal mines is to be a regulatory obligation of the individual mine owner and monitored regularly by the State government. The villages situated in close proximity to the mining operations and actively engaged in mining work are supposed to pay the pollution taxes from the additional gains they have reaped. When the NGT Court issued an order to cease mining operation in the region, glare violation of illegal mining frequently takes place. The Jaintias are considered to be residing above the mineral wealth where in recent years coal is an instrumental asset that can spur infrastructure expansion like establishment of private schools and colleges, road construction, and growth of allied activities thereby boosting the regional economy. Sadly the prominent mining villages failed to take note of the deteriorating environment and blatantly ignored the air and water pollution that is largely associated with the informal mining activities. Due to the non-compliance with post mining treatment of pollutants the after effect is a serious threat to human health and survival of animals.

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