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**Impact of Industrial Environment on Socio-economic Conditions of  
Mine Workers: A study of Coal Industries in Odisha**

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## ABSTRACT

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*Mining in India has an ancient origin and mining industry occupies a special position in the country's economy. The development of this industry is undoubtedly a milestone in the field of industrial development of the country. The mining industry has special features: the work is hazardous and the mining community living in relatively isolation from the rest of the population. First steps in the mining of coal in modern India may be said to have been taken during the thirties of 18<sup>th</sup> century. Among the minerals, coal- 'the black diamond', as a generator of 80% of the steam and thermal electrical energy in the country enjoys a uniquely strategic position. The large portion of the labour force working in the coal mines of Odisha, plays vital role in any scheme of industrialization and the development of the country in general and state of Odisha in particular. Modern technologies, increased awareness and mining legislation enable coal required by the nation to be mined without destroying the natural environment, retaining the mine area safe for working with lesser harm. Increase in work efficiency depends on a sound industrial environment around mining area. Working in mines involves physical accident and blows, muscular and nervous strain, monotony, noise & workers efficiency largely depends on work zone air quality and ambient air quality, extent of Suspended Particulate Matter (SPM). Different physical environments, say, coolness, heat, dampness and noise also influence the efficiency of labour and can be measured for purposes of correlating conditions and results in output, accidents, lost time and turnover. Working conditions should be compatible with an employee's physical comfort which contributes to enhance the job satisfaction by maintaining the normal temperature, combating humidity, proper ventilation, illumination, noise at work place. Good and favorable working conditions and a congenial working environment make the workers adaptable both physiologically and psychologically. Long hours of work and poor working condition sap the vitality of workers, render them inefficient making them physiologically unwilling to work. Hence a supportive environment is a prerequisite to keep the physical and mental stress of the employee at its minimum. In this paper we have tried to correlate the industrial environment of the coal mines to the workers efficiency and its impact on the performance of the industry and socio-economic conditions of workers. Though the Indian coal industry has been given a wide look, a special study has been carried in the Mahanadi Coal Fields in the Jharsuguda district of Odisha & stress has been given on three aspects like industrial environment, working condition & occupational hazards.*

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**Key words:** industrial environment, working conditions, occupational hazards & safety

# **I. Introduction**

In the process of industrialization and output generation, working community play a vital role. The working environment and working conditions of worker is equally important to that of capital and organization to promote sustainable development. The socio-economic condition of coal mine workers in this study covers various dimensions of workers such as: working conditions, work environments, occupational hazards and industrial accidents and income generation etc. The conditions under which the workers perform their duty have a great bearing on their general health, efficiency and productivity. The performance is affected by environmental problem such as temperature, noise, ventilation, humidity, work zone air quality and ambient air quality etc. The continuous exposure of the miners to such unhealthy atmosphere leads to fatigue and boredom ultimately leading to the serious fatal accidents. So it has been correctly said that a perfect man can be from a good and healthy environment. The piece of research is mainly meant of the economic policy measures for the control of environment pollution particularly in the coal industry. Since the coal industry has been already identified as one of the most polluted units in the country, this study is very much contextual and worthwhile from the angle of policy decision making. Again, the study is based on grass root level observation covering socio- economic aspect of the groups affected by the pollution due to coal mines. We are hopeful that it will provide a pragmatic approach to the policy measures in the context of pollution control.

## **II. Objectives of the study**

The main objectives of the present study are as follows:

- To examine the changes in the socio economic condition of the workers over a period of time.
- To examine the income pattern of the miners.
- To examine the degree of variability of income of company workers and contract workers.
- To determiner work environment and working conditions of the workers.
- To probe into the occupational diseases, health hazards and industrial accidents and to assess the measures taken towards these problems.
- To suggest appropriate policy measures on the basis of findings to raise the socio-economic conditions of the miners.

## **III. Coal Mining Scenario in India & the Area of Study**

India has a long history of commercial coal mining starting from 1774 by M/s Sumner & Heatly of East India Company in the Raniganj Coalfield along western bank of Damodar Valley. However, for about a century it remained sluggish due to lack of demand & it's the introduction of steam locomotives in 1853 which gave a fillip to it. With the advent of Independence the country embarked upon 5-year development plans and the need for increasing coal production by systemic & scientific development resulted in setting up National Coal Development Corporation (NCDC) in 1956. On account of burgeoning energy needs, unscientific mining practices and poor working conditions adopted by the private mine owners the central government took decision to nationalise the private coal

mines & it was done on two phases under the category of cooking coal mines and non cooking coal mines (1971-72).The Government of India formed various subsidiaries to the first company, Bharat Coking Coal Limited formed on 1.5.1972 which was initially a subsidiary of Steel Authority of India Limited to manage the taken over mines. In 1975 Coal India Limited was formed as a holding company with five subsidiaries namely Bharat Coking Coal Limited (BCCL), Central Coalfields Limited (CCL), Eastern Coalfields Limited (ECL), Western Coalfields Limited (WCL) & Central Mine Planning and Design Institute Limited (CMPDL).In view of projected increase in production and investment contemplated for CCL and WCL group of coal mines with their extensive geographical spread resulting in day to day administrative, technical & communication problems etc. two more coal companies namely, Northern Coalfields Limited and Southern Coalfields Limited were formed on 28.11.1985.

Considering the prospects of Orissa Coalfields, being the centre for VIII and IX plan periods, a new coal company was incorporated bifurcating South Eastern Coalfields Limited in the Mahanadi Coalfields Limited (MCL) with its headquarters at Sambalpur as fully owned subsidiary of Coal India Limited to manage the Talcher and IB-Valley coalfields in Orissa. Our present study is centered in this area covering nearly 22 mines and its workers. As a result of exploration carried out down to a depth of 1200 meter by the Geological Survey of India (GSI) and other agencies, a cumulative total of 240.748 billion tones of coal resources have been established in the country and Orissa has a handsome share of 59104 million tones spread across the state. From the existing 561 coal mines MCL operates over 22 mines in Orissa in which 13 mines are open cast and the rest are underground mines.

Jharsuguda district is one of the thirty district of Orissa created on 01.01.1994.It is bounded by sambalpur district in south,sundargarh in north,and the state of Madhyapradesh in west.This district has 5 blocks,2 municipalities, one NAC and 163 Grampanchayat.The area of the district is 2203.2 sq.km.The district is situated in the western part of Orissa.It has vast industrial potentiality.It is rich in coal and mines.This district is richly endowed with variety of valuables ores and minerals.The industries like Tata Refractories Ltd, Orient paper mills, Orissa power generation corporation, Bhaskar textile mills, and L andT cement plant are in operation in the district.

#### **IV. Methodology Adopted**

In this study data have been collected through primary and secondary sources. Primary data are collected through both census and sample surveys in the form of structured questionnaire through direct personal interview method. Secondary data are collected from various reports of CPCB, SPCB and mining offices at district level and state level. Collected data were edited, summarized, and analysed to arrive at conclusion. Average, Ratio, Percentage, standard deviation, coefficient of varitation, correlation and lorenze curve tools were used in the process of data analysis. Along with the empirical survey, the data from secondary sources have been used whenever required. Both underground and open cast mines were covered under the study. Information was collected from the workers, contractors, labours, welfare officers, and trade union leaders to make a comparative study. The interviewer has of and on lived with the miners in their cottages & quarters and also visited the neighbouring villages, mines hospitals, child official centers, crèche officials and interrogated the concerned person.

## **V. Socio-Economic Profile**

The present study relates to a socio-economic conditions of the coal mine workers of India with a special reference to a poor state Orissa, which has acquired a higher place in the mining industries. The goal of Indian society is to be a socialistic one. The speed with which we are marching towards that objective has not been fulfilled till the completion of sixty years of planned economic development. The coal mine workers of Orissa, who constitute the bulk of State mining forces, are quite away from a decent earnings, minimum and comfortable standard of living and working conditions. What have been done so far to provide a fair deal for the workers in the coalmines and what the government's intentions are for the immediate future constitute the main purpose of the present study. The present study will be of immense help for planning industrial development of Orissa as well as of India as a whole, as the workers employed in coalmines have been a major topic of discussion in the Indian economy, today. This study highlights how a social system, which frees man from all forms of exploitation, gives him broad democratic right, ensures a good living and working conditions and provide social security.

The socio-economic profiles of the workers are depicted in Table-1. Of the total workers 60% constitute company workers and 40% constitute contract workers. Among them 60% of company workers in the age group of 35 years and above where as 100% of contract workers are below the age of 35 years. It is observed that contract workers graduate into company workers over a period of time. The socio-economic profiles of the workers reveals that of the total workers 98.33% of company workers belong to Hindu community and 1% are of Christian community. On the other hand, 82.5% of contract



workers are of Hindu and 17.5% are of Muslim. By looking at caste wise distribution of respondents it is revealed that 46% of total workers are of general category where as 54% belongs to other categories. As Jharsuguda is a tribal district of Odisha in the country of India, the workers in Scheduled Caste and Scheduled Tribe categories are about 39% of total sample size. By looking at marital status of the sample it is observed that 77% of the workers are married and 23% are unmarried. The socio-economic conditions of the workers are changing day by day. The prospect of job in mining area is better and hence attracting the young and active workers into its fold. The details of the socio-economic conditions of mine workers can be examined by looking into income pattern, working conditions, occupational hazards and safety.

## **VI. Income Pattern**

The Socio-economic status of any social group is determined by the amount of income which show his actual social position and the mode of living. This socio-economic measure to a great extent determines the standard of living of any group of the society. The standard of living refers to the actual mode of living conditions. The mode of living in any country depends primarily on the fundamental factor of food, shelter, and clothing. But in different countries this standard of living varies due to the geographical importance of the region, racial characteristics of their people and differing values of money. According to ILO observation standard of living may be defined as “those goods and services, which a particular class of society is accustomed to”. The ILO has enlisted general levels of consumption food and nutrition, housing, education, health, recreational measures, conditions of work, employment and social security measures as the components of an international standard of measuring living standard. So the standard of

living is not same as the actual manner of living of a class or a community. It is an attitude towards a given mode of living. It is the scale of preferences plan for material living, which directs our expenditure into certain channel and satisfies our sense of propriety and decency as a mode of living.

Standard of living can be quantitatively determined and qualitatively grabbed by the planners, economist, and sociologists. A low standard of living is characterized by chronic under-nourishment, under-nutrition, inadequacy of something, which don't allow a worker to have average strength and competence etc. On the other hand a high level of standard of living is associated with a well-designed material development and a system organized to maintain it. In the present study attempt has been made to enquire into the income pattern of the mineworkers to measure the standard of living, which is the most vital indicator of socio-economic status.

### **Sources of Income**

Mining work is the principal occupation of workers of mining area of the district under study. Wage/salary is the main source of the income. However, due to inadequacy of their earnings they have to depend upon subsidiary occupations such as sales of forest product, part time works, small business like bettle shop, poultry, goatery etc. to supplement their earnings. Table-2 depicts the average monthly income from different sources by the workers in coalmines.

It is evident from the Table - 2 that more than 85% of the total monthly income is earned from wages and next to that it is the bonus, which constitute around 6%. Remaining earnings are from the supplementary sources. As regards bonus, Company workers are getting 8.8. % Whereas in contract system it is only 2.7%. In real sense there is no bonus

provision in contract system. Contractor pays only “Puja veti” i.e. a lump sum amount for puja expenses. There is no government rule regarding payment of bonus for contract workers. As the contract labours are unorganized in nature. To increase their incomes they stress on supplementary incomes like part time works, poultry & goatery, sales of forest product, the percentages are 6, 6 and 3.1 respectively. Along with their tribal habits they are compelled by the economic necessity to keep chickens, goats and cattle and sale these in the local markets. Sometimes minor inhabitants of the district are also sales agricultural products like rice and vegetables grown in their own land. Their children and wives also engage themselves in part time work in the officials of the mining area.

### **Variation in Income**

To show income variation between company workers and contract workers of the mining district under study, the statistical tools like mean, standard deviation and coefficient of variation have been used. The calculations have been made from the Table-3 and Table-4 for company workers and contract workers respectively.

From the table-3,

Mean income of company worker:	INR.5758.3
Standard Deviation of company workers:	858.7345
Co-efficient of variation of company worker:	22.8490 (%)

From the table-4,

Mean income of contract workers:	INR 3137.5
Standard Deviation of Contract Workers:	897.85
Co-efficient of variation of Contract worker:	42.0047 (%)

The following observations can be made on the basis of the above statistical findings derived from Table-3 and Table-4.

- (a) The company workers are getting higher average monthly earning than that of contract workers the difference between their income is Rs. 2621/-. And this remarkable difference is due to lower wage, non-payment of bonus and irregularity of employment among contract workers.
- (b) The value of standard deviation in monthly income of company workers and contract workers are 858.73 and 897.85 respectively, Which indicates that there is almost equal magnitude of deviation of monthly earnings of the individual workers from the mean income.
- (c) The higher value of CV as a relative measure of dispersion in case of contract workers 42.0047% show relatively greater scope for variation of their monthly income compared to that of the company workers i.e. 22.8490%. Here,

$$CV_2 > CV_1$$

This indicates that the wage paid by the contractors to the mineworkers does not concentrate within a narrower limited range. This represents lower uniformity. On the other hand wages and bonus paid to the company workers are maintained with uniform basis. On the whole we can say that the company workers earnings are more consistent, more stable and homogenous than that of contract workers in which there is lack of control over the contractor by the company authority.

The calculation of **Lorenz Curve** for variation of income among company workers and contract workers and the inter-variation between these two groups is shown in Table-5. From the table it is seen that there is no proportional income distribution between company workers and contract workers. The unevenness of income distribution is evident from the fact that in case of company workers 3.57 % of the income is shared by only 30% of contract workers. The share of income is unequal in which for 15% of income the share of company worker and contract workers are 3.34% and 72.5% respectively.

Figure -1 depicts the Lorenz Curve. This shows the degree of inequality in distribution of income. It is the cumulative percentage curve in which the percentage of items is combined with the percentage of other things as like income and workers respectively. In Figure-1 the curve A indicating the cumulative percentage of company workers with relation to cumulative percentage of income shared by them, represents less inequality in the distribution of income compared to curve B which indicates income distribution among the contract workers. The curve B is farther from OP i.e. the line of equal distribution, compared to curve A. Hence, income is not proportionately distributed both among the company workers and contract workers. This shows degree of variability among company workers and the contract workers. Inequality of income is more prominent in case of contract workers than company workers. The reason behind the different slope of the curve A&B is as follows: (a) Inequality in income distribution is due to the workers exploitation by the contractor paying lower wage,(b) Non payment of incentive bonus to the contract workers by the Coal India and (c) Irregularity in employment

## **VII. Work Environment and Working Conditions**

Increase in work efficiency depends on a sound industrial environment around mining area. Working in mines involve physical accident and blows, muscular and nervous strain, monotony, noise, unhealthy dust and air, which diminish and dampen workers efficiency. Different physical environments, say, cold, heat, dampness and noise also influence the efficiency of labour and can be measured for purposes of correlating conditions and results in output, accidents, lost time and turnover. Working conditions should be compatible with an employee's physical comfort. It contributes to enhance the job satisfaction by maintaining the normal temperature, combating humidity, proper ventilation, illumination, noise and work place. Good and favourable working conditions and a congenial working environment make the workers adaptable both physiologically and psychologically. Long hours of work and poor working condition render them inefficient and make them physiologically unwilling to work. So, on the whole we can say work environment has a considerable impact on the efficiency as well as on the health of the worker. Hence a supportive environment is a prerequisite to keep the physical and mental stress of the employee at its minimum.

Table – 6 describes about the physical work environment in mining area. The main environmental factors at the workplace are ventilation, temperature, noise and smell. Good working condition require that there should be satisfactory Ventilation at the workplace. Ventilation is a problem for under grounds mine workers. Out of nine mines four mines are underground and five are open cast mines. Majority of workers work in underground mines because of less mechanization. Open cast mines require fewer workers as adequate mechanization has been made for the same. However, 63% of the

workers are dissatisfied with ventilation system in which company workers and contract workers percentage is 55 and 75 respectively. From Table-6 it is observed that company is taking some steps for providing ventilation facilities whereas in contract system this have been neglected. A proportion 37% of workers, are of the view that ventilation is satisfactory. These group of workers are working in offices, and workshop areas. For underground mines, in spite of the adoption of different measures to carry oxygen inside the mines and keeping connection with outside air yet the working environment is found highly unhygienic which leads to health hazards. The bar diagram(Fig.-2) depicts the work environment factors in relation to effect on workers to draw the birds eye view.

Reasonable **Heat / Temperature** at work place is an essential working condition. The district under study is having the daily temperature fluctuating between 28°C and 47°C in summer season and less than 10°C in the winter season. The mining area of this district is area of extreme climate, too hot in summer and too cold in winter. During rainy season there is reasonable and tolerable temperature in mining area but due to rain the digging spots are filled with water, which leads to more accidents. Hence, the highest rate of absenteeism was noticed during the rainy season. Therefore the workers work with extreme climate in the peak seasons of the work.

In the underground mines, the workers were found working with a very high temperature throughout the year. Table - 6 shows 59% workers view that they work in too much heat, which includes 65% of company workers. All the underground mine workers are in company and as discussed earlier no contract workers are allowed to go inside the underground mines. So it is obvious that the company workers work in extreme heat

during their duty hours in the underground mines. Too much heat also prevails in opencast mines but that is due to climatic condition only.

**Noise** has also adverse effect on work efficiency of the workers. Physical effect i.e. power of communication and subjective effects i.e. creating annoyance are the two effects, which is created by noise in work place. In mining area blasting, drilling and breaking the big pieces into small creates noise. Movement of transported vehicle also creates noise. The evil impact of noise gives rise to various ear and nerve diseases. Due to physical effect, workers became less attentive to his work, which results in occupational accidents. This problem is more aggravating in underground mines than the opencast mines. 56% of the workers are working in the condition where noise is intolerable. 37% of workers are having noise but it is tolerable. This noise effect is of long run effect with diseases like, hard hearing and dumpness.

Effect of **Smell** is dangerous one. Smell of Chemical explosion, coal dust, carbon monoxide through transportation, gases in underground mines affect the respiratory system of the workers in the mines. The 63% of workers are working in an unpleasant smelling condition whereas as 24% of workers are injured by the smell. It implies that the smell in coal mines area have a disastrous repercussion on the workers health. Generally at the end of the service period workers are affected with diseases in respiratory system i.e. diseases of lungs and heart.

**Posture of work** in mining hampers the productivity of labour. Instability in workplace, working in standing position makes the job strenuous. This also leads to decrease in health condition. The table - 7 shows the posture of work of the mines in the coal industry.



It is observed from Table - 7 that 78% of workers in mine are working either standing or often changing condition. Hence, the jobs of mines are tedious and restless. Rest pause in taking launch and tea is not sufficient for them. Adequate rest pause should be provided to them for increasing productivity of labour. The 22% workers those who are working in sitting posture most of them are operating machines like, pay loader, dumper, dozer and shovel etc. Overall we can say that posture of work in coal mines dampen the productivity of the workers.

Table - 8 explains about the allotment of work to the workers. The working hours as per the standing order of MCL under the provision of the industrial Employment (standing order) Act 1946, the hours of work of the work man shall be fixed by the management from time to time. Presently the normal working hours fixed by the MCL management is 8 hours including rest pause. In the same order more then one shift be worked in a department or departments or any section of a department of establishment at the direction of the employer. If more than one shift is worked, a workman shall be liable to be transferred from one shift to another. No extra shift working would be started or discontinued without giving notice under section 9A of the Industrial Dispute Act, provided that no such notice shall be necessary if the extra shift working of discontinuance of a shift is under an agreement with the workman effected or their unions. Like other industrial workers. Workers of coal industry work in changing shift especially in production areas, whereas in other service areas they are fixed with the shift. Table - 8 says about shift duty of workman in coal industry. A proportion of 57% of workers are working in rotating shift where as the rest 33% are working in some fixed

shift. In fixed shift service, the coal mine have the medical service, office work, etc. To make production round the clock the rotation of shift work has been adopted. Workers engaged in production go for rotation in shift work, say morning shift, evening shift and night shift. The workers confess it during interview that production of coal diminishes gradually from morning shift to night shift.

The position of the worker in modern industry can be summed up by four “Rs”- Repetition, Routine, Red Tape and Risk in connection with his social environment in employment. Among the workers of miners in coal industry, it is cutting; breaking and loading are the main work, which they do during their work time. This is nothing but repetition and routine work for the miners. Routine and repetitive nature of work in mines lead to monotony and reduces the workers to a cog in the stones. While analyzing the above fact, it is pertinent to study the environment in which the mineworkers work. The nature of environment is reflected by workers reaction to it. These reactions are portrayed in Table - 8.

Table - 9 shows that 84% of the workers felt that the mining work what they have been assigned during duty hours are monotonous and strenuous. If a worker will do the work the same job over and above he will lose his interest and deal in his work. That has been occurring in the mineworkers under study. Monotony in job also reduces the productivity of the workers. To make these workers activate and encourage, the provision of economic facilities like production bonus should provided and some non-economic facilities like entertainment programs should be organized.

Out of frustration about monotony and strenuous job, workers are going for some supplementary occupation after their duty. These supplementary occupation is quite

different from the mining works viz. agriculture, sale of forest product, poultry etc. Table - 10 portrays the supplementary occupation done by the miners.

From Table - 10 it is observed that 54% workers are having supplementary occupation. Out of that percentage of company workers it is 56 and percentage of contract workers is 50. About 46% of the workers have no supplementary occupation, as they are basically migrant from other districts or states. There is also less scope of small business in the mining areas. The workers who come from nearby villages within 10 Kms. of radius are having agriculture, cow & buffalo, goatery and poultry etc. as the supplementary occupation. But other categories of supplementary occupations are small pan shops in cabin, tea staff in Jhumpudi i.e. small thatched house, agency in different financial organization like, LIC, GIC (those who are educated) found in mining areas.

## **VIII. Occupational Hazards and Safety**

Occupational hazards as observed in the field, occur due to (1) personal factors like negligence, carelessness, vanity etc. and (2) material factors like unguarded and defective machinery, industrial and chemical explosives, defective equipment and hand tools. Personal factors are mainly psychological and physiological in nature. Although it is generally recognized that psychological factors are important, the analysis of emotional and other mental causes remains exceedingly difficult. However all those circumstances which affect the attitude of the workers towards safety and job satisfaction is important. Accidents also occur due to environment and the general atmosphere. We may include under these, those factors which affect the security of employment, earnings of workers, hours of work and working conditions, group relationship, discipline, housing, living conditions and family circumstances. Fatigue and boredom may also increase the risk of

accidents. Fatigue makes workers less attentive, slower in action and neglectful of precautions. Physiological factors include age, health, defective vision, deafness, and intoxication. These defects are slight and may not be detectable without medical examination, and therefore proper attention must be paid to the general physical conditions of the workers. The second factor to cause accident is the existence of the hazards. Accidents caused by machinery, defective equipment etc are less in number. However, the former is important because of severity of the accident caused by the workers themselves.

From the above analysis we can conclude that accident can be prevented either by eliminating the personal factors or by removing hazards. It is generally difficult to eliminate the personal factors because they depend on so many things, but so far as removal of hazards is concerned it depends on the nature of the case.

International Labour Organisation (ILO) in its publication, "Accident Prevention" has recommended 12 factors to promote industrial safety and for prevention of accident in industrial concerns. These are: 1. **Regulation**; mandatory prescriptions concerning working condition, maintenance, inspection, testing etc. 2. **Standardization**: It may be laid down officially or non officially e.g. safe construction of industrial equipment, safe and hygienic practices. 3. **Inspection**: enforcement of mandatory regulation. 4. **Technical research**: to test the machine guards, properties etc. 5. **Medical research**: investigation of physical and pathological effect of environment. 6. **Psychological research**: investigation of the psychological pattern of the worker conducive to accidents. 7. **Satisfied research**: to less kind of accident, type of workers etc. 8. **Education**: teaching of safety. 9. **Training**: the practical instruction of workers. 10.

**Persuasion:** the use of various methods of publicity and appeal to develop safety-mindedness. 11. **Insurance:** the provision of financial incentives to promote accident prevention.

## **Safety Measures**

Safety measures may be divided into two types such as (a) statutory measure (b) non-statutory measures. In India “Safety mindedness” has not developed and the frequency and severity of accidents is still high in-comparison to other advanced countries. Occupational hazards can be minimized by adopting appropriate safety measures.

Table - 11 depicts the trend of fatal and serious accidents in coal mines in India from 1995 to 2005. Although extensive statutory provision have been made to prevent accidents the frequency rate of fatalities and serious accidents gradually diminishing in CIL. The graphic representation of this table to show the trend of accident rates and fatalities rates is shown in Fig. -3. This shows the decrease in the fatality rate since 1995. The number of fatal accidents declined from 137 in 1995 to only 34 in 2005 over a period of ten year. Similarly fatalities also declined from 219 to 35 in the above period. The case of serious accidents too decline during the period of time.

1. A Safety and Rescue Manual prepared by Coal India has been adopted for ready reference of all concerned on the safety and rescue aspects in mining. A code of practice for opencast Mines has also been laid down.
2. A system of periodic Safety Audit for all mines has been introduced and necessary action has been taken on the basis of the reports of the audit.
3. Major rescue stations have been provided in each company supported by a large number of rescue Rooms such that no coal mine is more than 35 kms. From the

Rescue Station/ Rescue Room. Some of these rescue rooms are also provided with facilities for refresher training.

4. Modern State of the art apparatus like BG-174 self contained Oxygen Breathing Apparatus, Maxman Auto-Reving Apparatus, Chemical Oxygen Type Self Rescuers have been provided and rescue training personnel are being trained or retrained for proper use of the rescue apparatus in rescue Stations.
5. Radio paging systems are being progressively are being progressively introduced in the Rescue Stations so that rescue bridge members can always be reached in the event of an emergency.
6. Infra-red equipment for locating persons through smoke is being introduced large diameter bore hole drilling equipment has been procured for rescue of personal trapped in below ground mines through bore holes.

Like in all other spheres of industrial activity, occupational hazards and safety in the coal industry is of prime concern and paramount importance owing to basically very arduous and hazardous nature of the mining operation. Safety in coal industry may be broadly classified as (1) work related safety; i.e. deployment of men and machinery which is inclusive of persons holding statutory testimonials with their competence being determined technically, the duties and responsibilities of the competent persons, operations and maintenance of equipment and machineries, mine planning and method of mining etc. (2) Environmental safety which relates to the mines environment viz. heat, humidity, noise, vibration, dust etc. It has a direct bearing on the occupational health of workers.

The basic legislations that govern safety are Mines Act 1952, Mines Rules 1955, Coalmines Regulations 1957, Mines Vocational Training Rules 1966, Mines Rescue Rules, Mines Crèches Rules and Indian Electricity Rules etc. These safety legislations have traversed a long way in incorporating changes and amendments attuned to the requirement of the contemporary age of the industry. Besides the aforementioned safety laws, documentary directives and guidelines, for confirming to the norms and standards are provided by the circulars of the Directorate General of Mines Safety (DGMS), safety conferences and court of inquiries.

Safety matters are also deliberated upon in various participatory committees that being both bipartite and tripartite in nature viz, pit safety committee, area and company level committee, standing committee on safety at corporate level etc. The governmental agencies or organizations connected with the safety in mines, which play very important role in interaction with the public sector undertakings, are Directorate General of Mines Safety (**DGMS**), National Council for Safety in Mines (**NCSM**) and Central Mining Research Station (**CMRS**). All are having their headquarters at Dhanbad, Bihar.

The **DGMS** is the agency, which functions as enforcement and implementation machinery as regards the statutory provisions on safety and also monitors implementation thereof by periodic inspection. It is conferred with the statutory power to launch persecution against persons or organizations found guilty of committing breach of the safety provisions in vogue. It is also vested with the statutory power to conduct examinations for certificate of competency for the managers, surveyors, over-man engine drivers and shot fires which includes certificate of competency for gas testing and camp checking etc. The **NCSM** conducts various training courses of the personnel engaged in

various technical disciplines and various jobs. It also publishes information materials, Documents and undertake multifarious activities on safety matters. The **CMRS** is one of the national laboratories of Council of Scientific and Industrial Research (**CSIR**) engaged in basic as well as applied research inter alia in the field of safety of mines and miners and reducing health hazards of mine workers.

The method of mining coal depends upon the location of the coal seam or deposit. If its location is in coal proximity to the earth's surface then the overburden is removed and the coal is exposed for production, which is called the **opencast method** of mining. If the coal deposit is far underneath the earth's surface a pair of diverge/shafts is made the surface to touch the seam and the coal is extracted, which is called the bord and pillate method or the **underground method** of mining.

The latest technological up gradation undertaken by the public the public sector coal companies both in the underground and opencast methods comprise of under mentioned equipments and machineries.

**Underground equipments:** 1.Cutting machines, 2. Coal drills, 3. Trunk belt conveyor, 4. Gate belt conveyors, 5. Light duty chain conveyors, 6. Medium duty chain conveyors, 7. Side discharge loaders, 8. Load haul duffers, 9. LOCUS: (a) trolleys, (b) battery (c) diese, 10. Haulage, 11.Winders, 12. Main pump, 13. Transformers, 14. Shuttle cars, 15. Gathering arms, 16. Coal tubs, 17. Dint headers and 18. Mine cans etc. **Open\_cast equipment :** 1. Drill, 2. Shovels, 3. Dozers, r., draglines, 5. Scrappers, 6. Dumpers, and 7. Front end loaders etc. The technological upgradation embraces all the sphere: viz exploration mining method, coal beneficiation, coal utilization, computerization etc. Now a correct and objective appraisal of the attitude of the authorities at various levels towards



all matter integral to safety and their performance on various counts is being made. The edge safety begins at the top, convey that the authorities at the top of any industrial undertaking should take any undertaking that should take the lead in promoting and maintaining the safety standard<sup>8</sup>. There are several recommendations by the DGMS according to the latest technological upgradation. But the most unfortunate aspect is that all these recommendations were put in the cold storage and even in the face of vociferous and persistent demand by the trade unions this implementation were shelved on various pretexts.

In the present study an attempt has been made to find out the initiative of MCL authority to implement the safety rules and recommendations by DGMS, and other safety committees and workers reaction thereof. As coalmines of the both the types i.e. open cast and under ground mines are existing in the district under study, MCL authority has been providing the required equipment's of latest technology to all mines. But sometime the safety kits like, helmet mask, boots etc have not been provided to the workers at particular interval. Sometimes due to negligence in wearing these kits the workers face accidents during duty hours. The Table - 12 portrays about the occurrence of accidents and the cause for occurrence of accidents.

From Table - 12 it is observed that 71% of the workers are confessing that they have faced accident during their service period. The injuries may be injurious or minor injury, 29% of the workers is yet to face any accidents. If we will take comparative statements of company workers and contract workers it is observed that 70% and 72.5% of workers respectively have already faced certain accidents during their service period. In case of contract workers percentage of accident is more than the company workers.

Reasons of occurrence of accident are explained in the bottom part of the Table -12 as well as in the Fig. - 4. From Table -12 it is observed that 38 workers out of 71 workers are getting the accidents in mining areas occurring due to poor safety measures by the company. It is 53.52% of total accident that occurs in the mining area.

In the theoretical part it has been explained that mining authorities are keeping the recommendations of the DGMS and the safety committee (bipartite or tripartite) in the cold storage and adequate attention has not been paid to the implementation of safety provisions in the mining area. On the other hand, everything cannot be shifted to the responsibility of the company authority to check accidents by adopting the safety measures. The workers are also responsible for occurrence of accidents due to irresponsible work done by them. 22.54% workers are confessing before the interviewer that they have faced the accident for their own irresponsible nature of work. In real sense this number may be more, as it is a mania among the workers that they want to avoid their fault and they shift their responsibility to the company. 16.9% accidents occur due to climatic conditions like cold, heat, etc. in the mining areas. Reasons of occurrence of accidents in case of company workers and contract workers are almost same and nearer in each case. Accidents due to poor safety provisions are 54.76% and 51.72% respectively. Accident due to irresponsible work done by the workers is 21.43% and 24.15% respectively and accidents due to climatic conditions are 19.05% and 13.79% respectively in respect of company and contract workers in the mining areas.

Injuries have been categorized as three types. Viz.1) fatal injuries, 2) serious injuries, 3) minor injuries. This classification is on the basis of the gravity of the accident i.e. degree of seriousness involved in the accident. Fatal injury is the case of permanent disablement. Serious injuries are the case of long treatment for cure and in case of minor injury it is a well-required treatment. As we have mentioned above, 71% workers have faced accidents during their service period, Table- 13 shows the degree of seriousness of accidents of those workers.

The Table -13 and Fig.-5 explains that more than fifty percentage workers are facing minor injuries. Next to that are serious injuries which constitute 52.12% and 32.39% respectively. Fatal injuries are 15.44% in which the cost of accident is not only borne by the employee himself but also by the family and the company and above all by the entire society. Accidents are enormously costly, caused directly or indirectly and the losses are both visible and invisible. The invisible losses are immeasurable and cannot be valued in terms of money. Nevertheless the nation surely pays a price for the same in one form or the other. They certainly affect the quantum of wages. Apart from this, fatal injuries cause agony and hardship to the family members. Due to the death or permanent disablement of the breadwinner, the family sometimes is reduced to a state of penury. The industry and consequently the nation is also taxed in the form of compensations to the injured persons. Table -14 portrays the rate of fatalities and serious injuries in CIL and MCL which bring a comparative view there by to prove the sincerity of the MCL authority to create awareness regarding safety in work place.

From the table it is observed that except in case of fatality rate, 3-lakh man shift MCL (0.355) is lower than that of CIL (0.24). It implies that the fatality and serious injury rates are less than the national figure which indicate the implementation of safety rules and awareness of safety consciousness is more in MCL.

Provision of safety equipment and other steps has been explained in Table - 15. 66%, 53% and 23% workers have been supplied with protective equipment like, boots, masks and helmets, and protective clothes respectively. But adequate attention has not been paid to the drilling of water below ground and there is lack of close supervision for which accidents are occurring in the mining areas. The percentage of drilling water below ground and supervision are 19 and 7 respectively, which shows a poor performance in the coalmine under study.

## **X. Summary and Findings**

Coal mining is one of the basic industries of India. Economic development of our country depends on the speed and efficiency with which the coal mining sector develops. Orissa is full of important minerals like iron ore, mica, coal, and chromites etc; which are meant for basic and heavy industries. Ib valley coal field, one of the subsidiaries of Mahanadi Coal fields Limited is located at Jharsuguda district of Orissa has 45 percent of total coal reserve in Orissa. There are nine coalmines and projects in this coalfield. The coalmines of the district in the Orissa as well as in the Indian economy enjoy a strategically important position.

The mining works is the principal occupation of the workers as observed in the field. Wages and salaries are their main source of income. We observe two categories of

workers i.e. Company Workers and Contract Workers. The company workers are getting higher average monthly income than contract workers.

The present study reveals that the working condition and the work environment are not congenial to the health of the workers. The miners in all mines except for a very few, work under risky, unhealthy and hazardous condition, which gives rise to the industrial fatigue and feeling of frustration among the workers. Due to manual nature of the work labour turnover and absenteeism is more in the industry. It has been proved through the hypothesis that labour turnover has a relationship with the blue-collar job. The jobs are not only manual but also heavy and strenuous. Of the total workers 77% are engaged in heavy and strenuous work whereas only 23% are doing light jobs. It has been shown that heavy and strenuous work in the mines leads to frequent illness, because of which the workers remain absent from duty. 69% of the workers remain absent from duty due to heavy and strenuous work. Remaining 31% remain absent due to participating in religious ceremonies, attending marriages and paying visits to their native places. Working in the mines involves physical accident and blows, muscular and nervous strain, monotony, noise, unhealthy dust and air, which bring down the workers efficiency. Poor ventilation and foul smell in underground constitute a serious problem. Open cast coalmines also have the same problem, which cause diseases in the respiratory system. Expenditures made by the Coal Company towards the welfare at work place appears scant and inadequate. The condition at work place such as extensive unbearable heat, irritating noise and unhygienic dust tells upon the efficiency of the workers and causes industrial fatigue. However, under such working environment the tribal workers discharge their duty up to the satisfaction and are found to be more efficient, industrious,

disciplined than the non-tribal. Often changing the posture of work and rotating the work shift reduces the work efficiency and productivity of the labour. 78% of the workers work standing and often changing conditions and 57% workers attend their job in the rotation shift. Taking psychological factors into consideration it is observed that 84% of workers are dissatisfied with their monotonous and strenuous job.

The present study reveals that the miners suffer from various occupational diseases and accidents due to adverse working conditions. Occupational hazards in coal mining occur due to (1) personal factors like negligence, carelessness etc; and (2) material factors like unguarded and defective machinery, industrial and chemical explosives, defective equipments etc. So in mining industry accidents are not uncommon. Some accidents result in a temporary or permanent disablement of the miners, which is the outcome of irresponsibility of the workers, poor supervision, and poor and inadequate safety measures made available by the company. Safety appliances such as globes, leg guards, goggles, helmets, boots, masks are not adequately supplied. Out of 71% accidents 54% accidents are due to poor safety measures. Climatic condition of the district also causes major accidents in mining area. Serious injuries are more than fatal injuries and minor injuries. Accidents are enormously costly which are both visible and invisible. Economically the cost of the accident is heavy for all concerned. The cost of the compensation payable to the family of the dead miners and injured workers, the cost of the time of the injured men and the cost of the lost time by their employees who stop work out of their curiosity and sympathy are tremendous. Adequate safety measures are essential to recover the loss to some extent.

## **XI. Suggestions**

While conducting survey, certain important factors have drawn our attention, about which we want to offer the following suggestions.

- Wages and salaries are not sufficient to run a decent life, it may be hiked.
- Exploitation of employer be minimized.
- Creation of new employment activities in the periphery.
- Coal dust being the chief cause of air pollution it is suggested to take appropriate abatement measure to control spreading dusts in the mining area. The possible steps are: (a) to take air quality management strategy like setting up air quality monitoring stations in the mining location; (b) adequate plantation of trees around the coal projects so that it will check the wind flow from mining area to the 'basti' area.
- Medical facilities at work place should be provided to all the workers and the workers must be trained in giving first aid.
- Clean drinking water facilities should be provided to all work place as well as to the 'basti' areas. Proper spray of water at a regular interval on the main roads of the mining area for avoiding dust is essential. The safety department should ensure this.
- Informal education and appropriate training etc. should be provided to the illiterate and ignorant miners regarding their environment and working conditions to avoid occupational hazards and diseases.

- Proper display of information on the notice board and display of pamphlets in square places is essential regarding the causes of occupational hazards, awareness camp on safety to maintain consciousness through out the year. The message of safety policy must be passed on to all levels in letter and spirit.
- **‘Prevention is better than cure’** the message of health statute should reach each and every worker so that accidents and occupational diseases can be checked to a great extent.
- Last but not the least the government should create ideal industrial environment and good working conditions for the workers in the coalmines, those who produces ‘black diamonds’ for us which ultimately strengthen the country’ economy.



**Table-1: Socio-Economic Profile of the Respondents**

Indicators	Company workers				Contract Workers			Total
	18-25	26-35	36-45	46-60	0-18	19-25	26-35	
Age	5	19	24	12	1	26	13	100
Religion	Hindu	Muslim	Christian	Total	Hindu	Muslim	Christian	Total
	59	-	01	60	33	7	-	40
Caste	SC	ST	OBC	GEN.	SC	ST	OBC	GEN.
	9	18	10	23	3	9	5	23
Marital Status	Married		Unmarried		Married		Unmarried	
	55		5		22		18	

**Table-2: Average Monthly Earnings of the Mineworkers from different sources in Ib Valley Coalfield.**

Sl.No	Source of income	Company Workers		Contract Worker		Total workers	
		Amt. in Rs.	% of the total	Amt. in Rs	% of the total	Amt. in Rs.	%of the total
1	Wages	6520.0	87.4	3495.0	86.0	5007.8	86.9
2	Bonus	656.0	8.8	87.8	2.7	372.2	6.5
3	Sales of Forest product	77.2	1.1	90.0	2.0	83.6	1.4
4	Sales of chicken/ goat, milks etc	130.0	1.7	175.0	4.3	152.6	2.7
5	Part-time works	76.6	1.0	215.0	5.0	145.8	2.5

**Table-3: Calculation of Mean, Standard Deviation, and Co-efficient of Variation of Monthly Income of Company Workers.**

Monthly income in Rs. ( $X_1$ )	Mid Value of income group ( $M_1$ )	No. Of Workers ( $f$ )	Deviation from assumed mean ( $M_1-A$ ) ( $M-5750$ )	Step deviation $M-A/i$ . $i.=500$ (d) i.e. common factor	$fd$	$fd^2$
4000-4500	4250	02	-1500	-3	-6	18
4500-5000	4750	11	-1000	-2	-22	44
5000-5500	5250	12	-500	-1	-12	12
5500-6000	5750	14	0	0	0	0
6000-6500	6250	09	+500	+1	+9	9
6500-7000	6750	07	+1000	+2	+14	28
7000-7500	7250	02	+1500	+3	+6	18
7500-8000	7750	03	+2000	+4	+12	48
<b>Total</b>		$\Sigma f = N$ <b>=60</b>			$\Sigma fd$ <b>=01</b>	$\Sigma fd^2 =$ <b>177</b>

**Table-4: Calculation of Mean, Standard Deviation, and Coefficient of Variation of Monthly Income of Contract Workers.**

Monthly income in Rs. ( $X_2$ )	Mid Value of income group ( $M_2$ )	No. of Workers ( $f$ )	Deviation from assumed mean ( $M_2-3750$ )	Step deviation $M_2-A/i$ $I=500$ ( $d$ )	$fd$	$fd^2$
2000-2500	2250	12	-1500	-3	-36	108
2500-3000	2750	10	-1000	-2	-20	40
3000-3500	3250	07	-500	-1	-7	07
3500-4000	3750	03	0	0	0	0
4000-4500	4250	05	+1500	+1	+5	5
4500-5000	4750	01	+1000	+2	+2	4
5000-5500	5250	01	+1500	+3	+3	9
5500-6000	5750	01	+2000	+4	+4	16
<b>Total</b>		$\Sigma f = N$ <b>=40</b>			$\Sigma fd$ <b>= -49</b>	$\Sigma fd^2$ <b>=189</b>

**Table-5: Calculation of Lorenz curve for Variation of Income Distribution Among Company Workers and Contract Workers. (in%)**

Income				Company Workers			Contract Workers		
Monthly Income range	Mid value	Cumulated income	Cumulated %	No. of Workers	Cumulated Nos	Cumulated %	No. of Workers	Cumulated Nos	Cumulated %
2000-2500	2250	2250	-	-	-	-	12	12	30.0
2500-3000	2750	5000	-	-	-	-	10	22	55.0
3000-3500	3250	8250	3.57	-	-	-	07	29	72.5
3500-4000	3750	12000	8.57	-	-	-	03	32	80.0
4000-4500	4250	16250	15.00	02	02	18.34	05	37	92.5
4500-5000	4750	21000	22.86	11	13	28.67	01	38	95.0
5000-5500	5250	26250	32.15	12	25	41.67	01	39	97.5
5500-6000	5750	32000	42.86	14	39	65.00	01	40	100.00
6000-6500	6250	38250	55.00	09	48	80.00	-	-	-
6500-7000	6750	45000	68.57	07	55	91.67	-	-	-
7000-7500	7250	52250	83.57	02	57	95.00	-	-	-
7500-8000	7750	60000	100.00	03	60	100.00	-	-	-

**Table - 6: Distribution of Respondent by Physical work Environment in Mines.**

Type of workers/ Environmental factors	Company Workers		Contract Workers		Total No(%)
	No.s	%	Nos.	%	
<b>Ventilation</b>					
Satisfactory	27	45.00	10	25.00	37
Unsatisfactory	39	55.00	30	75.00	63
<b>Heat</b>					
To much	39	65.00	20	50.00	59
Normal	21	35.00	20	50.00	41
<b>Noise</b>					
Tolerable	27	45.00	10	25.00	37
Intolerable	28	46.67	28	70.00	56
No Noise	05	8.33	02	5.00	07
<b>Smell</b>					
Pleasant	8	13.33	5	12.00	13
Unpleasant	34	56.67	29	72.50	63
Injurious	18	30.00	6	15.00	24
<b>Total Sample units</b>	<b>60</b>	<b>100</b>	<b>40</b>	<b>100</b>	<b>100</b>

*Note: Figures in the % column are calculated from the respective vertical total of sample unit.*

**Table - 7: Posture of work at Work Place in Mining area**

Working position	No. Of workers
Sitting	22
Standing	38
Often changing condition	40
<b>Total</b>	<b>100</b>

**Table - 8: Distribution of Respondents by Work allotment of Mine workers in MCL.**

<b>Work allotment</b>	<b>No. of workers</b>	<b>%</b>
Day shift	9	9
Evening shift	4	4
Night shift	11	11
Regularly one shift	19	19
Rotating shift	57	57
<b>Total</b>	<b>100</b>	<b>100</b>

**Table - 9: Distribution of Respondents on the basis of Psychological feeling of workers towards their work.**

<b>Type of Workers/ Monotonous &amp; Strenuous work in job</b>	<b>Company Workers</b>	<b>Contract Workers</b>	<b>Total</b>
Yes	56	28	84
No	1	10	11
Indifferent	3	2	5
<b>Total</b>	<b>60</b>	<b>40</b>	<b>100</b>

**Table - 10: Supplementary Occupation of the mineworkers**

<b>Type of Workers/ Supplementary Occupation</b>	<b>Company Workers</b>	<b>Contract Workers</b>	<b>Total</b>
Yes	34 (56.67)	20 (50)	54
No	26 (43.33)	20 (50)	46
Total	60 (100)	40 (100)	100
<b>Types of Supplementary Occupation</b>			
Agriculture	15	5	20
Sales of Forest product	4	5	9
Poultry	6	1	7
Goatery	3	4	7
Cow & buffalo	8	1	9
Others	8	5	13

*Note: Bracketed figure is the percentage of respective total*

**Table-11: Trends of fatal and serious accidents in coal mines in India.**

Year	Fatal accidents		Serious accidents	
	Accidents	Fatalities	Accidents	Injuries
1995	137	219	757	813
1996	131	146	677	723
1997	143	165	677	725
1998	128	146	523	560
1999	127	138	595	650
2000	117	144	661	707
2001	106	141	667	720
2002	81	97	629	650
2003	83	113	563	578
2004	90	99	599	608
2005 (up to 12.05.05)	34	35	340	344

Source: [WWW.Coalindia.nic.in](http://WWW.Coalindia.nic.in).



**Table -12: Distribution of Respondents by their view on Occurrence of Accidents & causes of accidents in coalmines**

Type of workers\ Occurrence of accident	Company Workers		Contact Workers		Total	
	No.	%	No.	%	No	%
<b>Yes</b>	<b>42</b>	<b>70</b>	<b>29</b>	<b>72.5</b>	<b>71</b>	<b>71</b>
<b>No.</b>	<b>18</b>	<b>30</b>	<b>11</b>	<b>27.5</b>	<b>29</b>	<b>29</b>
<b>Total</b>	<b>60</b>	<b>100</b>	<b>40</b>	<b>100</b>	<b>100</b>	<b>100</b>
<b>Reasons for occurrences of accidents</b>						
Poor safety measure	23	54.76	15	51.72	38	53.52
Irresponsible work by the workers	9	21.43	7	24.15	16	22.54
Climatic condition (Cold, heat, dust etc)	8	19.05	4	13.79	12	16.90
Any other	2	4.76	3	10.34	5	7.04
<b>Total</b>	<b>42</b>	<b>100</b>	<b>29</b>	<b>100</b>	<b>71</b>	<b>100</b>

**Table -13: Types of injuries (degree of seriousness of accident).**

Type of injuries	Total No.	%
Fatal injuries	11	15.49
Serious injuries	23	32.39
Minor injuries	37	52.12
<b>Total</b>	<b>71</b>	<b>100</b>

**Table - 14: Rate of fatalities and serious injuries in CIL & MCL.**

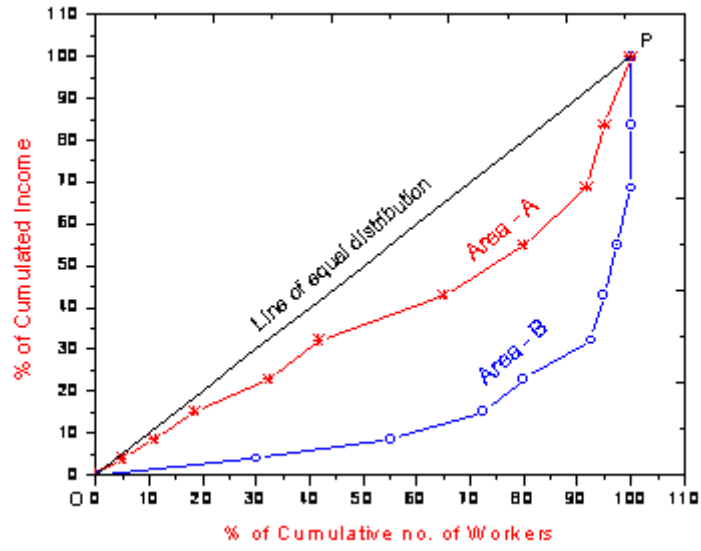
Fatality & Injury Rate	CIL	MCL
Fatality rate per MT	0.39	0.143
Fatality rate for 3 lak man shift	0.24	0.355
Serious injury rate per MT	1.49	0.335
Serious injury rate for 5 lack man shift	0.92	0.829

Source: <http://www.coalindia.nic.in>

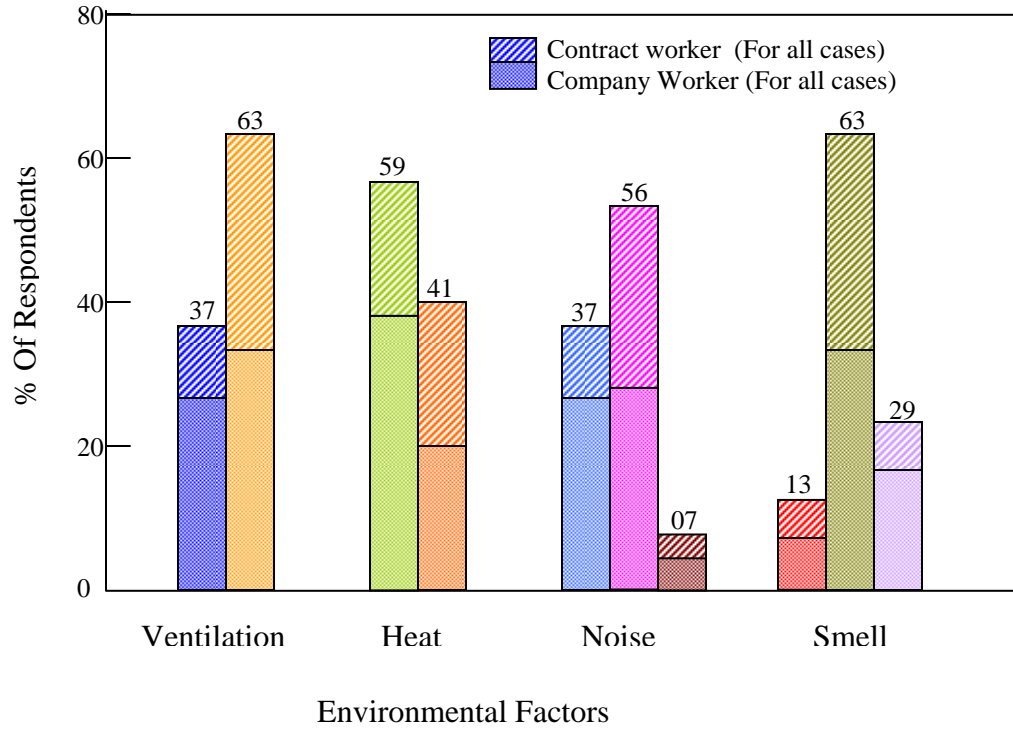
**Table - 15: Distribution of Respondent by Safety provisions for mine workers in MCL.**

Safety Provisions	Number of workers
Drilling of water below ground	19
Provision of boots	66
Mask and helmets	53
Protective clothes	23
Close supervision	7
<b>Total no. of workers</b>	<b>100</b>

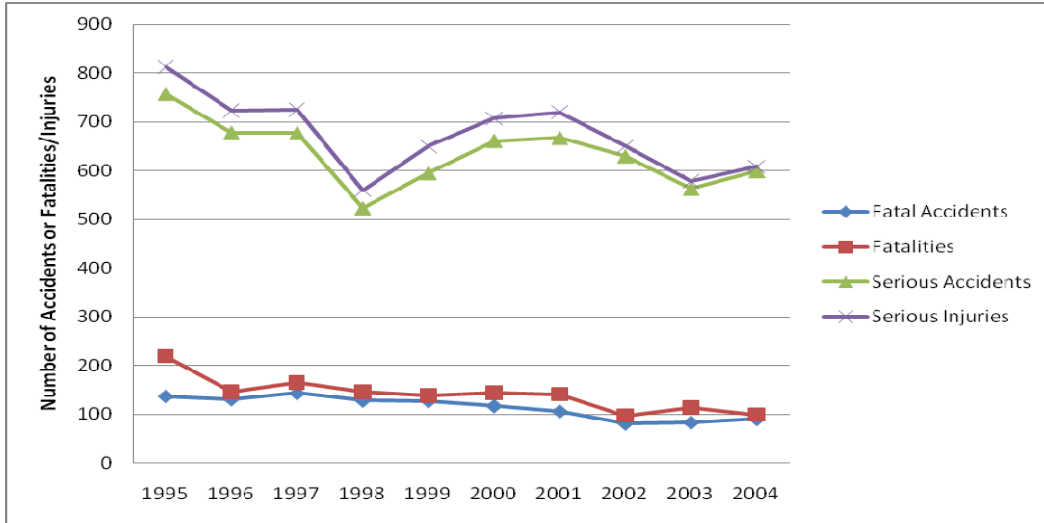
**Fig - 1: Lorenz Curves for variation of Income Distribution among Company Workers and Contract Workers(in %)**



**Fig- 2 Physical Work Environment in Mining Area**



**Fig-3: Trends of fatal and serious accidents in coal mines in India.**



**Fig.- 4 : Reasons For Occurance of Accidents**

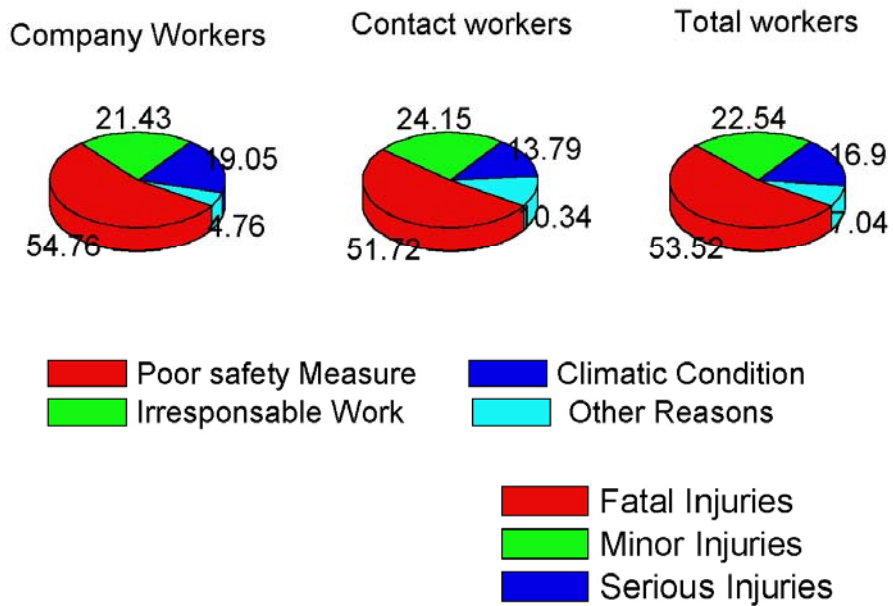
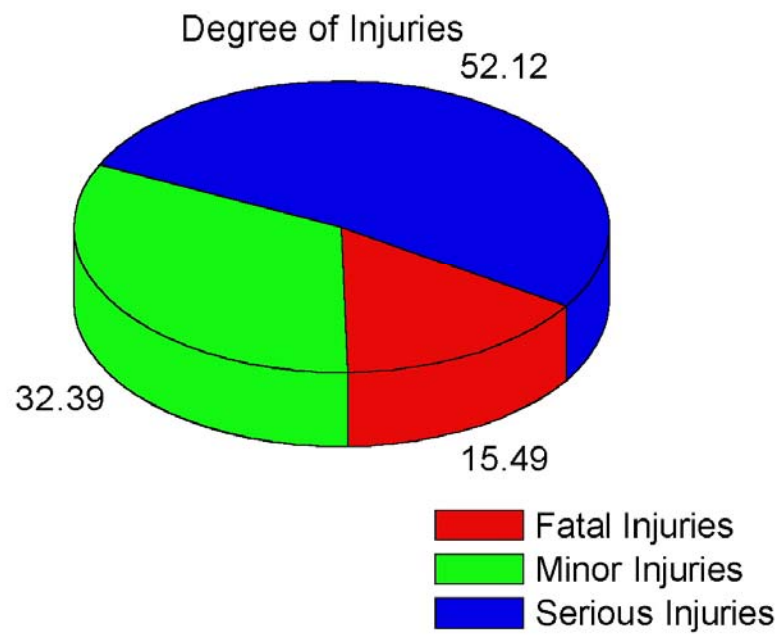


Fig. - 5: Degree of Injuries



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