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The Study on Big Data and Coal Mining Impacts on Environment

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Abstract – Coal mining is negatively impacting the environment as a whole. On the fragile world, the chaotic human race is continually utilizing a range of tools for everyday life. Coal has been known as India's primary source of electricity for many decades and leads to about 27 per cent of the world's industrial energy requirements. Coal is primarily extracted using two types, surface or opencast, and underground mines. The process of mining is dictated by the geological environment. Coal mining is generally correlated with the depletion of environmental wealth and ecosystem loss. This allows invasive species to inhabit the region, posing a danger to biodiversity. A variety of mining operations in the coal mining area create large amounts of waste material. Mining can harm the natural ecosystem if due consideration is not taken for the handling of waste. The waste management system impacts ground, water and climate and, in effect, the quality of life of residents in surrounding regions. This paper focuses on the pressing problems of coal mining and their effect on the ecosystem.

Key Words – Big Data, Coal Mining, Impacts on Environment, Impact from Coal Use

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INTRODUCTION

Since the popularization of the network has rapidly increased, there are a lot of new methods for releasing information showed up. Additionally, the rise of cloud computing technology and Web of Things technology makes the data growing and accumulating with unprecedented speed. Today is the age of big data. The attribute of data has changed, which is not only a kind of object that is waiting for being processed but also becomes a basic and crucial resource. Academic, industry and even government have shown a keen interest in big data technology, and a lot of data scientists have started a series research about big data. The application of big data today has coved very widely areas, such as business, industry, IT, medical treatment, education, and so on. How to achieve a better management and utilization of big data has attracted much attention.

Big data itself is a very abstract conception. We can literal understand this as “massive data.” However, this literal meaning is far from the accurate definition. Actually, there is no such an official definition for big data. However, based on the summarize of the properties and functions of big data, we can conclude the definition as ‘3V’ theory: Big data is a kind of loaded size of data which contains the properties of Volume, Variety, and Velocity. Besides, Value, was came up by IDC; Veracity, was came up by IBM, can also be included in the properties of big data [3].

Big Data Processing Tools

There are a lot of other processing tools for big data. Some of them were created just for big data, while some of them were not created for processing big data first, but it can be used as the big data process tool due to their outstanding function. This section will describe two as they represent of big data processing tool. One that was created for big data, which is Hadoop, and the other one is Python, which can be used for process big data.

Hadoop

Hadoop is the most talked big data management product today, and it is an open source implementation framework of MapReduce. It is a powerful tool that allows several computers work at same time. Hadoop at first was created by Doug Cuutting, but it available under Apache 2.0. The Hadoop ecosystem includes file system HDFS (Hadoop Distributed File System, database HBase, and data processing MapReduce. Using MapReduce, Hadoop allocates data to sections of a set of nodes operating on existing hardware. It is specialized in working with various kinds of data, such as organized, semi-structured & unstructured data, and relate to big data[4].

Python

Python is a extensively utilized powerful object-oriented high-level interpreted programming language. It becomes most popular dynamic programming language since it was published. The most outstanding feature of Python is that it has a vast and active scientific computing community. Python has been improving its library support for years, such as panda, has made it as a reliable alternative for data manipulation tasks. Considered with its powerful programming strength, it is an excellent choice for data analyzation[5].

Coal Data Be Classified as Big Data

Coal is a principle resource for human beings. It contributes a lot for human society to go into advanced. Coal also plays a significant part for economic growth promoting and energy security ensuring, which cannot be replaced. However, the utilization of coal and development of coal industry have also caused ecological damage and environment pollution and other issues.

Since the big data come into being, its applications cover wide areas. Recently, scientists started developing big data technique in the coal industry and did a series of research on data of coal. Some people doubted whether coal data could be classified as big data; while some people believed that coal data is big data and big data technique will help solve the issue that caused by coal.

Coal is a kind of energy source which is widely used and critical to human beings. There are many types of data in coal area based on the deferent usage and research. In the research for the big data, the data could contain a lot of different kinds of experimental data, such as Methane Adsorption Isothermal Analysis, Gas Content Analysis, and Gas Content Analysis. In the exploration of coal, the data could contain massive data that creates by IOT. Also, the data about coal also cover many other areas, such as the coal import and export record, and accident record in the coal mine. All the data contribute a lot in the coal industry [7].

Data in Coal Industry vs. Big Data

The 3V conception of big data is the most basic one: volume, velocity, and variety. In order to determine the data of coal is big data, we just need to find out whether the properties for data of coal is matched with the conception of big data.

- **Volume**

1. Geophysical Center - At the Geophysical Center, R&D spending is about four broad categories - collection, processing, interpretation and hardware optimization - all rich three pairs of large data (volume, variety, and speed). An original seismic data set is usually a few hundred megabytes, resulting in millions of megabytes once a lot of expensive handling and explanation. These processing algorithms calculate billions of data points, each run, hundreds of these operations occur every day, all one of the goals - to create a clear and accurate picture of the Earth's underground and identify all the major components of the hydrocarbon system[6].

2. IOT is widely used in coal mine - According to the definition of big data, the data includes not only the regular data prepared by human and website clickstream data but also the real-time data generated by the Internet of Things technology, including the data generate by RFID, camera, GPS, Terminals, sensor networks and other devices. It can be said that the Internet of Things is a major source of big data.

3. Individual Research - It seems that one research project might have limited amount of data. However, a lot of professors have been conducting research in coal field for more than 30 years and the data has been accumulated. The big amount of experiments which related with coal has been done by the researches around the world. The data from those experiment is in a large size.

- **Velocity**

Velocity means speed. It does not only mean the fast speed for transmits the data but also means the data is created dynamically.

[7] illustrated that the information comes from the coal mine have a high requirement of real-time. As the underground work condition is dangerous and uninterrupted produce for 20 hours, the safety monitoring systems will keep gathering and transmitting data without stop.

- Variety

Variety means the format of data is variety. Usually, the regular data are well structured. For example, the data stored in Excel, or MySQL database. However, big data sets may contain unstructured data and different types of data, such as words and pictures. [8] Significant data were incorporated in the oil and natural gas industries. During the well operating cycle, all the geological elements are very significant and are technologically demanding in the drilling of wells. Data from such modules may then be obtained using sensors and displays formatted in images, numbers, and so on.

Mining activity imposes huge pressure on local flora and fauna, especially where the conversion of forest land for mining is taking place. The effect of mining on ground water flows, the silting of nearby water sources and land is also of particular concern. Coal mining is a major contributor to the economic growth of the country, but it also has a direct effect on human safety. This also has an influence on the socio-cultural context of employees and residents living in and near coal mining regions. A comprehensive approach to mining operations is therefore required, keeping in mind the concerns regarding local environments and the environment. This includes the detection of different locations where minerals occur, as well as numerous other considerations ranging from an correct angle of slope of overload dumps, secure drainage drains, and effective strategies for different silt management systems, etc. In India, coal producers are now moving on a clean-coal policy aimed at growing the environmental impact[10]. The decreased ash content of the washed coal improves the thermal performance of the combustion cycle. This has a strong effect on the elimination of pollution and contaminants. The method of coal washing takes extra energy, so it will help us push towards a pollution-free environment. The combustion of coal produces toxic pollutants such as sulfur dioxide, nitrogen oxide, carbon dioxide, and ash and dust particles. Dangerous rates of air and water emissions have been recorded in coal-fired regions. Globally, it is known that coal production is negatively impacting the local and global climate. Mining negatively impacts the natural ecosystem by removing trees, inducing significant surface degradation and modifying microbial populations. Coal mining frequently impacts the natural atmosphere by producing coal bed methane, which is almost 30 times more potent a greenhouse gas more carbon dioxide. Coal mining thus has a detrimental effect on air quality standards[11].

Underground mining triggers groundwater loss in certain areas, as well as subsidence, etc., resulting in surface and nutrient destruction. Subsidence of the soil outside the limits permitted includes the filling of the subsidence area[12]. The relocation and redistribution of the citizens impacted, including a shift of culture, identity and related features, as well as an rise in crime and other illicit activity due to the immediate economic growth of the region, can be seen to have a negative social and cultural effect. Any of the beneficial impacts of mining ventures include improvements in job trends and income levels, shifts in services and economic growth. Developments of connectivity, infrastructure, schooling, commerce, leisure and medical services, etc. are some of the significant impacts. It is also evident that coal mining results in environmental disruption, but there are also beneficial benefits of industrial growth as well as greater self-reliance by improved production of accessible mineral resources. While there is no alternate site for mining activities, alternatives for position and processing equipment will potentially mitigate environmental harm. In this way, coal mining has a multi-dimensional effect on the environment, either directly or indirectly.

IMPACTS FROM MINING

Surface mining are either by strip mining, often using draglines to remove the excess and then restore it in the mined-out area, or by open-casting, with the surplus being evacuated and deposited elsewhere. Underground mining is essentially a colon bolster technique, with the coal dividing between the columns that remain to support the roof at that level. A limited volume of coal is extracted by long walling, in which all the coal in the crease is disassociated and the roof is enabled to collapse behind the extracted-out area. Among both these methods, strip mining is perhaps the most inherently well disposed among. This that come as an astonishment to a few, in the light of the bad reputation of the methodology. That is to a large degree in the context of the reality that the plan has acquired popularity to demolish the scene by leaving piles of virtually sterile destruction. When the mine is in operation, that is a legal study, so after the mine is over, recovery will begin. Restoration has to be done, so one of the main items that occurs after the mine is opened is to remove the topsoil so place it separately.

When the reconstruction is possible, the ruin is covered by the exhumation, the earth is examined and the top soil spreads and plants. For now, it is possible to rebuild the soil with the ultimate intention that the earlier existence of a mine will turn out to be virtually unnoticeable. There is some danger that subsurface hydrology might have been irretrievably disrupted and threaten the introduction of acidified water, but because most of the coal (from which acidity is produced) has been excreted and as the coal steps are mostly below the local water level, the danger is minimal and may, as a rule, be mitigated by near proximity to the ground water level. In fact, strip mining is inherently benign and more practical than surface mining, as it extracts all extractable coal for other uses and uses. There is a possibility that certain dinty, uneconomic or second-rate cracks will not be extracted, but will be mixed with ruin and thus add to the danger of acid age either from the ruin stacks or from the round in the extracted-out area, and there are scarcely any methods for retaining a strategic buffer from this problem when this occurs. Luckily, it is rare, because as a rule, uneconomic upper crevices are made physical, because reclaimed, by the very act of strip mining.

Opencast mining is rehearsed as the terrain renders strip mining unsuitable. The model is the massive Grootegeluk coal mine in the province of Limpopo. The simple coal measurements are about 80 m thick and lie below a few meters of overburden. The coal is scattered in slender creases combined with groups of shale and stone – the store in the vertical field approaches a monumental uniform description. There is then around 10 m of hard stone, and an auxiliary amount of coal is contained. They comprise large coal groups a few meters thick. The results of opencast mining are common. Tremendous overburdened dumps, frequently filled with squandered fuel, scattered over the skyline. In these dumps, coal can burn precipitously and radiate sulfurous vapor and smoke. The mine must continually create a giant trap, which increasing, in the long run, fill up with water and provide leisure.

Underground mining occurs because the coal fractures become too large to be in any way able to rise and remove the overburden. Normally this occurs when the coal crease reaches > 40 m long. The standard depth of underground mining in South Africa is just 80 m, which is a shallow comparison to the other coal mines across the globe. The store is mined by pressing square "places" about 10 m long and deserting columns to keep up the roof. Since the cracks are generally not uniform equally, it is challenging to mine "broad walls" where all the coal is extracted and the roof left to collapse behind the extracted-out field. In South Africa, only about 5% of underground coal is extracted by longwalls. The environmental consequences of underground mining are common. Methane is one of them. Methane is a "greenhouse gas" which is multiple times higher in its greenhouse effect than carbon dioxide, so methane is forming in the environment at a faster rate than carbon dioxide (albeit off a lower base). All of the fuel includes some methane. The deeper the mine, the greater the methane in the coal. When mining proceeds, the methane is pumped into the soil of the mine and eventually emitted into the world. By now, South Africa transmits around 7 million tons of carbon dioxide equivalent each year from deep coal mines.

A further consequence is the deterioration of the roof in the long haul between the walls. This will weaken the surface structures of the terminal and render the surface virtually unusable. Much more detestable is the danger that the coal in the columns can heat and eventually ignite. When the flaming column crumples, the roof collapses, conceding air and enabling the fire artifacts to flee. The exact degree of this mystery is under examination, but the starting gauges indicate that a ton of carbon dioxide is generated annually from this field as from the age of democracy in South Africa. Land over smoking, worked-out mines becomes absolutely unusable. The columns often cover an immense surface region, and the sulfur mixtures in the fuel are slowly oxidized upon injection into the soil. When they oxidize, they produce acid, and the acid will pass out, thereby giving an elevation of 'acid mine drainage.' Thankfully, many South African mines are below the local groundwater level, so as long as the mines are abandoned so overflowed with mud, the coal and acid production ceases. Some dirty water exists, but the impact is almost small[13].

SURFACE IMPACTS

Most coal is treated after exiting the mine to satisfy consumer demand requirements. Processing waste can be used for power storage, and South Africa has a proud record of learning to burn nearly incombustible waste comprising as much as 45 per cent ash. However, nearly 80 million tons of coal waste are deposited annually. This is a chance of combustion, and the dumps are compacted to minimize the ingress of air and filled with soil deposits to help mitigate the danger of burning. When lit, the dumps become very difficult to clear, so some of the dumps left from past generations are already smoldering. One of the impacts of burning dumps is the production of sulfur oxides. Sulfur compounds are contained in waste and thus add much more than the comparable volume of renewable energy. The climate of the Highveld has been heavily toxic for several years, but the steady extinguishing of the burning dumps has seen a noticeable change in ambient conditions.

Another danger from surface dumps is the gradual oxidation of the sulphur compounds as well as the leaching of the subsequent acid by rainwater into the waste. Covering the dump decreases the percolation risk, but most dumps give rise to a limited volume of acid that is captured and neutralized.

IMPACTS FROM COAL USE

The greatest energy requirements in South Africa is the power production sector. It produces approximately 170 million tons of carbon dioxide per year, approximately 0.7 million tons of nitrogen oxides and approximately 1.5 million tons of sulfur oxides. Some stations have too wide stacks to spill above the mixing point, and the predominant winds bring contaminants out into the Indian Ocean where they scatter.

Thanks to the fact that the typical coal burn produces a little more than 1% of sulfur, which is small by other criteria, sulfur emissions cannot be considered as extreme. Sulfur recovery is theoretically feasible, but it is not commercially viable in South Africa. Most of our production is powered by cheap electricity – the average sent-out cost is R0.065/kWh, rendering it one of the cheapest power in the world. It is projected that the recovery of sulfur would add at least R0.15 to this expense and would require millions of money that would be probably better spent on job creation and services. Carbon dioxide emissions are the natural consequence of the production of energy. Some South African power stations are massive (~4000MW) and powerful (more than 34% thermal efficiency), which minimizes their releases per unit of energy produced. There is some doubt that transmission losses are more than 7%, but this is the result of having a big nation with a fairly scattered population. There are few issues with Ash from electricity production. The finer fraction is used almost exclusively as a cement additive. The larger fraction has little leachability, so it poses a minimal threat to the aquasphere. Although thick, dispersion into the environment is nearly unlikely, but there are no consequences of air contamination.

Perhaps the biggest issue is the uranium level of 300-600 ppm.

It is initially of little interest, because much of the radioactivity comprises of other reactive or gaseous elements, such as radon, which are released during the combustion phase. Nevertheless, when the ash is processed, the radioactivity is recovered through normal processes. Ash is close to other granites, except since the ash dump is more flexible than solid material, there is a better risk of dispersion.

CONCLUSION

Coal mining has a muti-dimensional effect on the environment, either explicitly or indirectly. That reflects on the environmental effects of coal mines. Clearly, when calculated against the importance of the sector to the national economy, the residual influence of mining as such is small. Different comments may be made on much of the impacts of the usage of gas. Of course, the abundance of inexpensive coal renders the South African economy a big emitter of greenhouse gasses per capita, but the advantages of providing cheaper electricity greatly outweigh the possible impacts of our exposure to global warming. That becomes obviously shown as renewable electricity is cheap and maybe as many as 5 million people face the risk that their life expectancy would be seriously impaired by the exploitation of fuel. This is a simple and demonstrable relation, on the other side, we cannot find a single citizen in a nation whose existence is demonstrably adversely affected by global warming.

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