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The Vital Role of Overland Conveyors in the Transportation of Iron Ore: An Environmental Case Study in the NEB Range, Sandur Taluk, Karnataka

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***Abstract*— This study explores the use of overland conveyors in the North-Eastern Block of Karnataka, India, to transport iron ore. The research aims to reduce environmental impacts and improve efficiency in the transportation of bulk materials over long distances. The study compares the environmental footprint of conveyor systems with traditional methods like trucking and railways. The findings show that overland conveyors significantly reduce greenhouse gas emissions, land disturbance, and energy consumption compared to traditional transportation methods. The study emphasizes the importance of incorporating technological advancements like overland conveyors in mining activities to promote environmental sustainability and ensure efficient logistics in transporting iron ore. The study underscores the need for the North-Eastern block of Sandur to optimize capital expenditure and incorporate modern technologies in its mining activities.**

***Keywords*— Overland Conveyors; NEB Range; Mining Activities.**

I. INTRODUCTION

The Bellary-Sandur-Hospet mining sector in Karnataka, renowned for its rich iron ore deposits, faces significant risks due to the high-speed operation of thousands of trucks used for ores transportation. In regions like the NEB Range of Sandur Taluk, Karnataka, where environmental concerns are paramount, addressing these challenges is crucial for sustainable resource management. According to information obtained from police sources, in 2022, there were 48 fatal accidents attributed to the high-speeding Lorries, leading to the tragic loss of 42 lives and leaving 6 individuals physically disabled. The following year, 2023, witnessed a surge in accidents, totalling 57, with 49 fatalities and 8 individuals sustaining serious injuries due to the speeding Lorries. (Source Vijaya Karnataka newspaper dated 15.01.2023)

JSW Steel, with a 13 MTPA steel production capacity, requires 23 MTPA iron ore. Its expansion plan is underway to increase its steel production from 12 MTPA to 15 MTPA. Other players, including BMM Ispat, Kalyani Steels, SLR Metallics, Kirloskar Ferrous Industries, and DRI units, require around 12 MTPA. Currently, industries in Ballari, Vijayanagar, and Koppal districts require around 35 MTPA iron ore. The increase in iron ore production for targeted steel production necessitates large-scale mining operations and significant environmental control measures. The open movement of large quantities of iron ore by road could increase traffic load on public-private partnerships (PWD) roads and pollution.

In recent years, overland conveyors have emerged as a promising alternative for transporting bulk materials like iron ore over long distances. These conveyor systems offer numerous advantages, including lower operating costs, reduced environmental impact, and increased operational efficiency. By utilizing advanced technology and innovative engineering solutions, overland conveyors have the potential to revolutionize the transportation of iron ore in environmentally sensitive areas like the NEB Range.

This study aims to explore the vital role of overland conveyors in iron ore transportation, focusing specifically on the environmental implications in the NEB Range of Sandur Taluk, Karnataka. By conducting a comprehensive case study, we seek to evaluate the environmental performance of overland conveyors compared to traditional transportation methods. Through a combination of quantitative analysis and qualitative assessment, we aim to assess the sustainability and efficiency gains associated with the adoption of overland conveyor systems in iron ore transportation.

By shedding light on the environmental benefits and economic feasibility of overland conveyors, this study seeks to inform policymakers, mining companies, and stakeholders about the potential of this technology to mitigate environmental impacts while ensuring the continued viability of iron ore transportation in the NEB Range and similar regions. Through collaboration and innovation, we can pave the way for a more sustainable and environmentally responsible approach to iron ore transportation, ensuring the long-term prosperity of both the industry and the surrounding ecosystems.

II. STUDY AREA:

The research area (Fig.1) is located in the northeastern part of the Sandur Schist Belt, Ballari District, Karnataka State. It spans latitudes 15.257787°N to 15.088812°N and longitudes 76.356183° E to 76.607385°E. The area covers 165 sq km and has a topography of hills and flatlands. The Sandur Schist Belt, known for its hilly terrain, hosts several mining leases for Iron and Manganese Ores.

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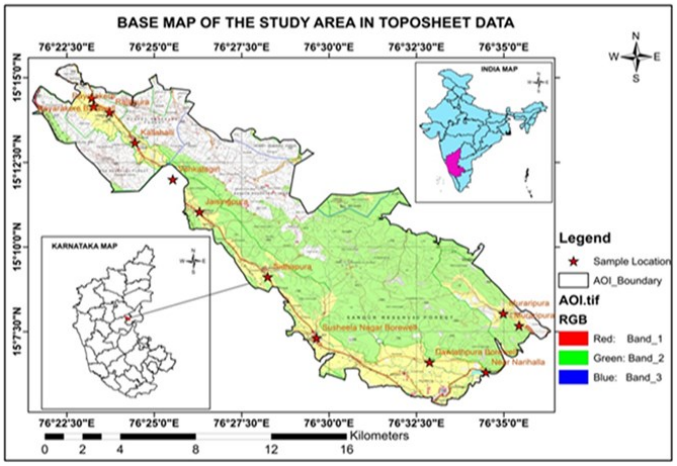

Fig. 1. Base Map of the study area.

III. OPERATIONAL CHALLENGES IN THE STUDY AREA:

The study area is facing significant environmental pollution issues, including dust emissions and vehicular exhaust from iron ore mines. Mining companies from the NEB and Ramgad range use the road network, causing noise pollution and accidents. These stressors threaten the local ecosystem and nearby communities' well-being. It is crucial to implement measures to alleviate and control these pollution sources.

The transportation of iron ore by tippers through these villages has seen a significant surge. Data collected from two Kallahalli check post (Table 1 and Fig.2) reveals Avg. 29,951 trucks per month and Sushilanagar check post (Table 2 and Fig.3) reveals Avg. 32368 trucks per month on Sandur-Hospet these two checkpost data reveals that over 750 loaded iron ore trucks, accompanied by an equivalent number of empty trucks, totalling more than 1200 trucks per day. traverse through all five villages covered in the study area.

TABLE I. IRON ORE TRANSPORTATION THOUGH KALLAHALLI CHECK POST.

Month	No. of Vehicles		
	Year 2022	Year 2023	Year 2024
JAN	22345	30532	38038
FEB	21463	24166	23617
MAR	22776	30971	24054
APRIL	16769	22204	19133
MAY	17907	30145	-
JUN	13848	27575	-
JULY	15417	18576	-
AUG	14993	25040	-
SEP	21649	25274	-
OCT	14202	22318	-
NOV	20832	25058	-
DEC	27382	34049	-
Average Vehicles per month	20783	28598	28472

TABLE II. IRON ORE TRANSPORTATION THOUGH KALLAHALLI CHECK POST.

Month in the Year 2024	No. of Vehicles
JAN	28227
FEB	27741
MAR	38815
APRIL	31705
MAY	35350
Average Vehicles per month	32368

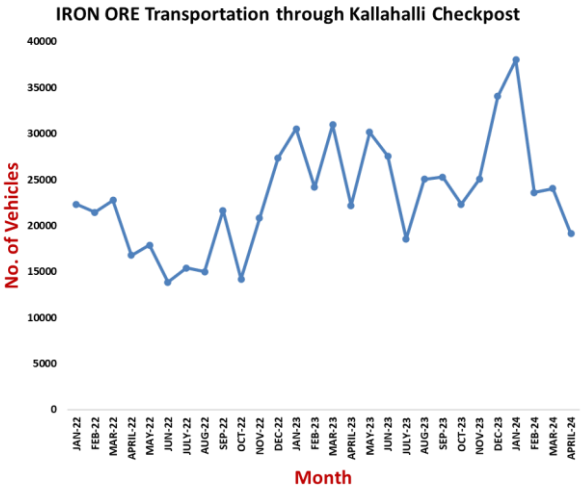

Fig. 2. Graph showing iron ore transportation through kallahalli checkpost.

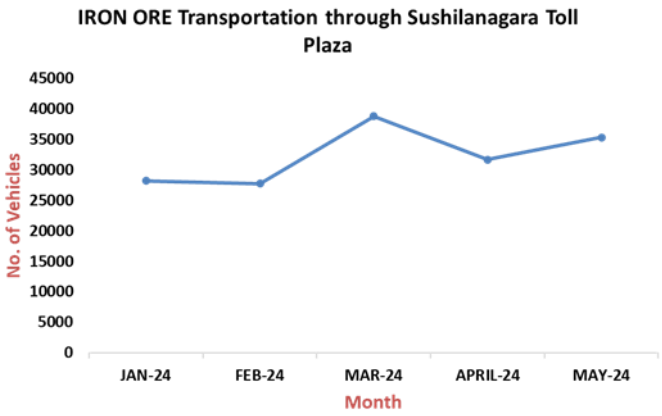

Fig. 3. Graph showing iron ore transportation through Sushilanaga checkpost

Consequently, we recommend that mining companies operating captive mines in the study area consider the installation of Main Pipe Conveyors and Downhill conveyors for transporting ore to their steel plants.

However, when evaluating the total long-term expenses, the advantages of an overland conveyor system justify the higher initial investment. Main Pipe Conveyor and Downhill conveyors can be effective in mitigating air and noise pollution during the transportation of iron ore compared to traditional truck transportation. Here's how downhill conveyors can contribute to pollution reduction.

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A. Energy Efficiency: Downhill conveyors utilize gravity for material transport, reducing the need for additional energy compared to uphill transport. This leads to lower energy consumption and, consequently, fewer emissions from energy generation sources.

B. Reduced Fuel Consumption: Traditional transportation methods, such as trucks, may require combustion engines and fuel consumption for uphill transport. Downhill conveyors eliminate the need for fuel-powered uphill transport, thereby reducing overall fuel consumption and associated emissions.

C. Air Quality Improvement: As downhill conveyors decrease the reliance on diesel-powered vehicles, they contribute to improved air quality. Diesel engines are a significant source of particulate matter and nitrogen oxide emissions, and by minimizing their use, downhill conveyors help mitigate these pollutants.

D. Noise Reduction: Downhill conveyors generally operate with less noise compared to trucks and other traditional transportation methods. This reduction in noise pollution can positively impact the surrounding environment and communities near mining operations.

E. Lower Environmental Impact: The overall environmental impact of mining operations is reduced with downhill conveyors. They offer a more sustainable and eco-friendly alternative to traditional transportation, aligning with modern environmental standards and regulations.

F. Reduced Truck Traffic: By using downhill conveyors, the need for a large number of trucks for transporting materials is reduced. This result in lower traffic volumes on roads, thereby contributing to a decrease in both air and noise pollution associated with truck transportation.

G. Decreased Accident Risks: The average mining trucks, weighing several hundred tons and with tires measuring over twice the average adult's height, necessitates around seven maintenance and operation workers to keep it operational. This substantial workforce increases the risk of accidents significantly. Truck fleets encounter safety challenges like navigating rugged terrain, adverse weather conditions, and the potential for spilled loads.Conversely, conveyors can be constructed over challenging terrain, reducing both the distance travelled and safety risks. They can be built over railroads, rivers, and bridges, providing a safer alternative.

H. Environmentally friendly: Mining haulage trucks, being massive and consuming large amounts of diesel fuel, pose environmental concerns. This fuel consumption raises the risk of violating environmental regulations, particularly in sensitive areas. The U.S. Department of Energy's Mining Industry Energy Bandwidth study revealed that diesel equipment used in materials handling is less efficient than electric equipment. Diesel transportation, such as trucks, constitutes a significant portion of energy use, accounting for 87% of total energy for materials handling. However, diesel systems operate at a low efficiency of 30%.

In contrast, electric equipment, such as conveyors, demonstrated higher efficiency, reaching up to 95%, and accounted for only 48 trillion Btu annually. Unlike diesel-powered vehicles, electric systems produce no local exhaust emissions. Conveyor systems also include various internal safety features to securely hold materials on the belt during an emergency manual shutdown. Moreover, they primarily use electric power, thereby significantly reducing emissions and supporting a more environmentally friendly mining operation.

Actual data from real-world scenarios demonstrates numerous benefits associated with conveyor systems. An illustrative example from a Brazilian iron ore mine serves as a compelling case study, highlighting the substantial benefits associated with conveyor systems compared to trucks. The introduction of a semi-mobile conveying solution led to a remarkable reduction in CO2 emissions, amounting to 29,376 tonnes annually. This represents a notable 29% decrease in emissions compared to a scenario relying solely on truck transport. The case underscores the environmental advantages and sustainability gains achievable through the strategic implementation of conveyor systems in the mining sector.

In conclusion, Overland Conveyors offer a multitude of advantages that make them a preferred choice for material transport in mining operations. These advantages not only improve safety and efficiency but also contribute to a more sustainable and cost-effective mining paradigm.

IV. OTHER ISSUES RELATED TO OPERATION OF MAIN PIPE& DOWNHILL CONVEYORS IN FOREST AREAS:

Conveyor belts are a popular method for transporting iron ore but concerns about their 24-hour operation have been raised due to the noise they produce. This noise creates vibrations on the ground and can negatively impact wildlife, especially during nighttime activities. Studies should be conducted to evaluate the impacts of increased timing of the Main Conveyer Belt in the study area before project implementation. The objective should be to identify the impacts of conveyor belt operations on the activity and habitat use of important faunal elements and assess the extent and significance of potential impacts resulting from increased timing.

The Main Pipe Conveyor Belt system, which transports iron ore from mines to steel plants, generates a noise level exceeding 50 dB, causing concerns about the impact on wildlife and human populations, particularly during nighttime activities. Continuous sound may also adversely affect nocturnal animals, leading to potential communication challenges for amphibians, crickets, and bats.

To maximize the effectiveness of downhill conveyors in reducing pollution, a comprehensive environmental impact assessment is necessary, considering terrain characteristics, local regulations, and community concerns. Best practices in conveyor design, maintenance, and operation are also crucial.

V. CONCLUSION:

Overland conveyors are a strategic and sustainable solution for the Sandur-Hospet mining sector, addressing operational challenges, economic growth, environmental preservation, and

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community well-being. They play a pivotal role in transforming the dynamics of iron ore transportation in the area. Overland conveyors offer economic advantages, operational efficiency, environmental sustainability, infrastructure development, and safety considerations, making them an indispensable solution for the region's mining industry. As demand for iron ore continues to grow, embracing these innovative transportation methods will contribute to the long-term success and sustainability of the mining sector in Sandur taluk.

Conveyor belts have also revolutionized material handling procedures, involving specialized cover materials, advanced joining techniques, and creative designs. These innovations improve durability, efficiency, and safety in the challenging mining environment. The incorporation of monitoring systems, enhanced splicing technologies, and effective cleaning mechanisms allows mining companies to enhance conveyor belt performance, reduce downtime, and ensure smooth material flow across operations. Conveyor belts remain a crucial element in the mining sector, facilitating efficient transport of bulk materials and playing a significant role in productivity and success.

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