SUSTAINABLE MINING AND GEOINFORMATION

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Lecture 33: SDG 3, 4 & 5

Welcome, today let us talk on the sustainable development goal number 3, 4 and 5. What are their implications as far as sustainable mining is concerned and how they can be achieved or how geoinformation can be of any use to this three Sustainable Development Goals (SDGs) number 3, 4 and 5. The concepts covered monitoring health and well-being in terms of sustainable development goal number 3. So, there we need to achieve in terms of the pollution impacts, disease mapping and all this has to be monitored. In second ensuring inclusive and equitable education opportunity which comes in sustainable development goal number 4.

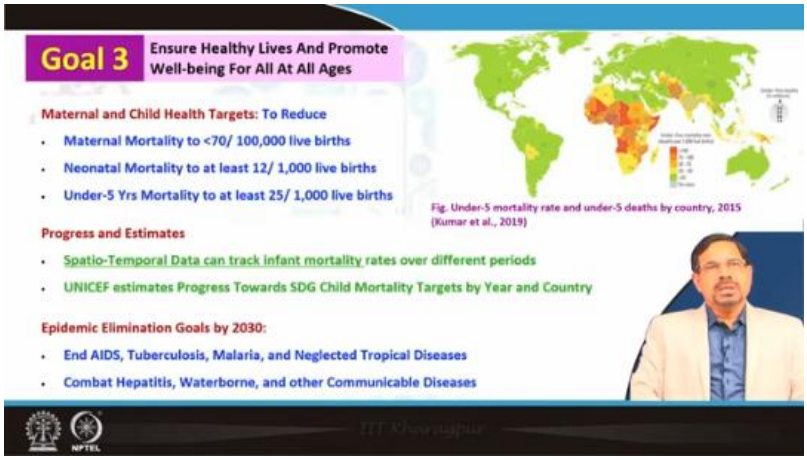
Then promoting the gender equality and reducing inequality in terms of sustainable development goal number 5. And, towards the end we will talk about a case study that deals with evaluation of primary schools and its accessibility using the geo information tools. So, as far as goal 3, 4 and 5 are concerned, goal 3 aims to ensure healthy lives and thereby promoting well-being for all ages that means group of all ages starting from infants to the elderly people. So, there in terms of the mining industry sector and how

what are the intersect as far as the geo information tool is concerned. These four has been noted or prioritized.

The first one could be monitoring environmental health risk. Second could be the emergency responses and disease control. And third is how to maintain safety in mining workspace and fourth is the disease epidemiology in the mining region or the colony. The fourth one could be focus. So, focus on ensuring inclusive equitable quality education and promoting lifelong learning opportunities.

So, here the implications as far as geoinformation tools are concerned in the mining industry sector are, the first one could be educational programs using the, geospatial technology and the second is knowledge dissemination in the mining community. Third, the geoinformation tools can be used for generating education-related documents and also in terms of resource management in the education sector. And the fourth is empowering schools near the mining sites. These four have, in general, implications, in various areas. So, specifically, they have also, they are also applicable to the mining industry sector.

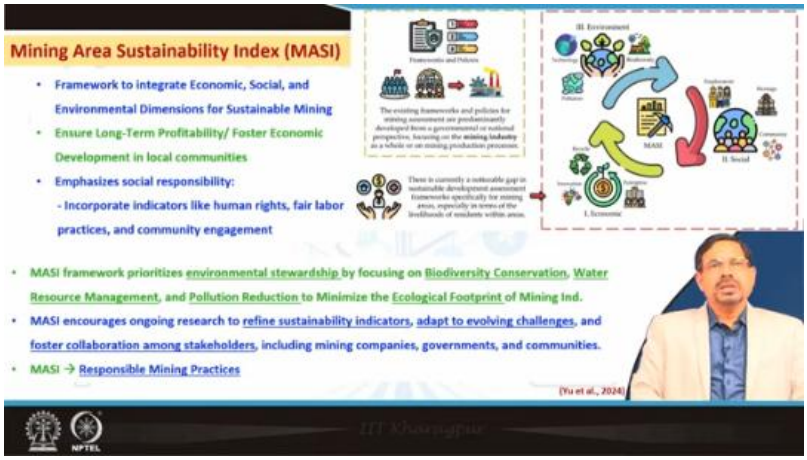
The goal number 5 SDG aims to achieve gender equality and thereby empower women and girls. So, the mining industry and the geoinformation intersection could be promoting gender inclusion in mining jobs, addressing gender-specific health impacts. Educational empowerment for women in the mining sector and also monitoring the gender disparity in mining areas. So, let us start with goal number 3 in detail, that promises in terms of healthy lives and promoting well-being for people of all ages. So, the maternal and child health targets MSAT reduction of maternal mortality to less than 70 per every 100,000 live births.



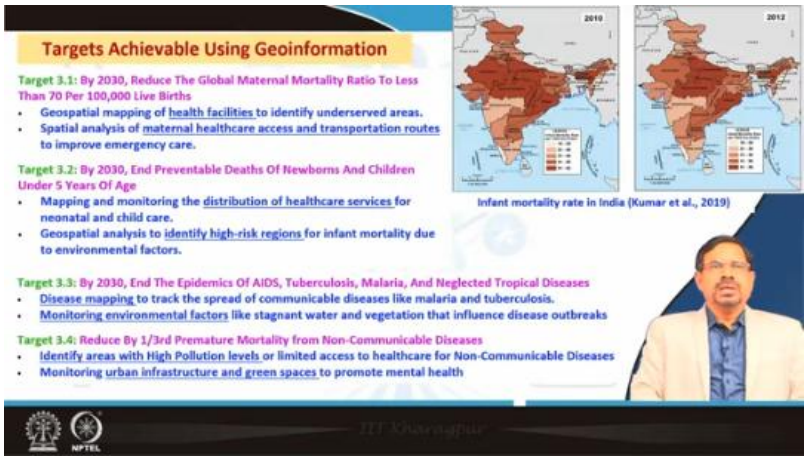
Neonatal mortality to at least 12 per 1,000 live births and under-5 years mortality to at least 25 per 1,000 live births. So, to achieve all these three, particularly the people living in the mining industries or who have a relationship or who are attached to the mining activities. So, what are the progress and the estimates? Spatio-temporal data can track the infant mortality rates over different periods as far as the mining sector is concerned. So, this can well corroborate or, well, can be attributed to UNICEF or, you say, UNICEF estimates the progress towards the sustainable development goal child mortality targets by year and country.

So, that is how it complies as far as the mining industry is concerned with the child mortality target on an annual basis, per sector, and per country basis. And the epidemic elimination goals by 2030 or the end of this particular decade. So, it aims at ending diseases or epidemics such as AIDS, tuberculosis, malaria, and neglected tropical diseases, thereby combating hepatitis, waterborne, and other communicable diseases. So, this is a target that needs to be achieved by the end of this decade, by 2030. These activities benefit from geoinformation tools as far as the mining sector is concerned.

So, let us see an index called MASI, abbreviated as MASI, that is the Mining Area Sustainable Index. It is an index that talks about or frames a framework to integrate economic, social, and environmental dimensions for sustainable mining. This index, MASI, ensures long-term profitability, fosters economic development in local communities, and emphasizes social responsibility. So, this MASI index is developed using geoinformation tools that have the power to integrate both spatial and non-spatial data as far as SDG goal number 3 is concerned. So, thereby, this MASI helps in incorporating indicators like human rights, fair labor practices, and community engagement.



And, this particular framework, which is very widely used, the MASI, prioritizes environmental stewardship by focusing on biodiversity conservation, water resources management, and pollution reduction. So, as to minimize the ecological footprint as far as the mining sector or the mining industry area is concerned. So, this index also encourages. Ongoing research to refine sustainability indicators, adapt to evolving changes, and foster collaboration among stakeholders, including mining companies, government, and communities. So, as a whole this mining and areas sustainability index MASI it is responsible for all sorts of mining practices that has implications as far as the sustainable development goal number 3 is concerned. So, let us see the targets that can be achieved using the geo information tools. So, as far as the SDG target 3 is concerned let us look at the details. So, target 3.1 that talks about reduction of the global maternal mortality ratio to less than 70 per 1 lakh births by end of this decade. So, how this is benefited from geospatial tools as far as the mining sector is concerned.

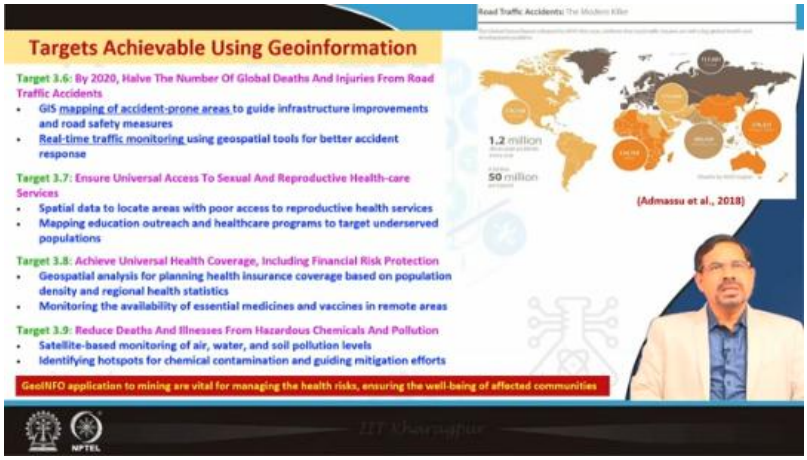


So, this geoinformation based mapping of health facilities is useful to identify the underserved areas. The spatial analysis of maternal health care access and transportation

routes is useful to improve the emergency care as far as mining sector is concerned. Let us talk about target 3.2 that aims at ending preventable deaths of newborns and children under 5 years of age group that is that has to be achieved by end of this decade that is 2030. So, mapping and monitoring the distribution of healthcare services for neonatal and childcare is benefited from geo information tools. And, this tool also helps to identify high risk regions for infant mortality due to the environmental factors.

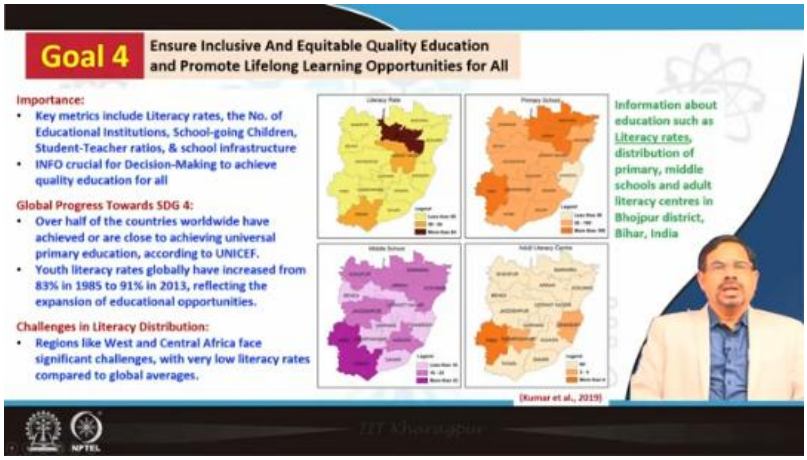
As far as target 3.3 is concerned that aims at ending the epidemic such as AIDS, tuberculosis, malaria and neglected tropical diseases. Here also the geo-information tools help in mapping different diseases that is useful in terms of tracking the spread of the communicable diseases like all this has been mentioned such as malaria and tuberculosis. The geo-information tool also helps in monitoring environmental factors like stagnant water and vegetation that influence disease outbreaks. Target 3.3 aims at reduction by one-third in terms of the premature mortality from non-communicable diseases. So, geoinformation function helps in identifying the areas with high pollution risk or limited access to health care for non-communicable diseases and also helps in monitoring urban infrastructure and the green spaces to promote better mental health.

As far as the mining sector is concerned, this has a this is very very useful in terms of the applications of geoinformation. Then coming to target 3.6, it aims at making the number of the global deaths and the injuries from road traffic accidents by half. So, the reduction by half to by end of 2020 the year has already we have already crossed. So, the geoinformation based mapping of accident-prone areas to guide the infrastructure improvements and the road safety measures as far as the mining sector is concerned. So, the real-time traffic monitoring using the giant function tool within the mining areas helps in terms of better accident response in terms of generating better accident response measures.



As far as target 3.7 is concerned ensure an universal access to sexual and reproduction health care services. So, here geo information helps in locating areas with poor access to reproductive health services and also this geo information helps in mapping the education outreach and healthcare programs to target the unserved or unserved populations. As far as target 3.8 is concerned, that aims at achieving universal health coverage including financial risk protection, geoinformation based analysis is useful for planning the health insurance coverage based on population density and the regional health statistics. So, similarly the gene formation technology is useful in monitoring the availability of essential medicines and vaccines in remote areas within and the surrounding the mining areas or mining industry areas are concerned. Target 3.9 aims at reduction of deaths and illness from hazardous chemicals and pollution.

So, if we do satellite based or drone-based monitoring of air, water and soil pollution levels can be identified, monitored, measured and monitored. And, thereby this geoinformation helps in identifying the hotspots for chemical contamination and guiding mitigation efforts. So, in general geoinformation applications to mining are vital for managing the health crisis, health risk, ensuring the well-being of affected communities. Let us go to the SDG goal number 4 that aims at inclusive and equitable quality education and promoting lifelong learning opportunities for all of us. So, the importance is to come out with key matrices that include that include literacy rates, the number of educational

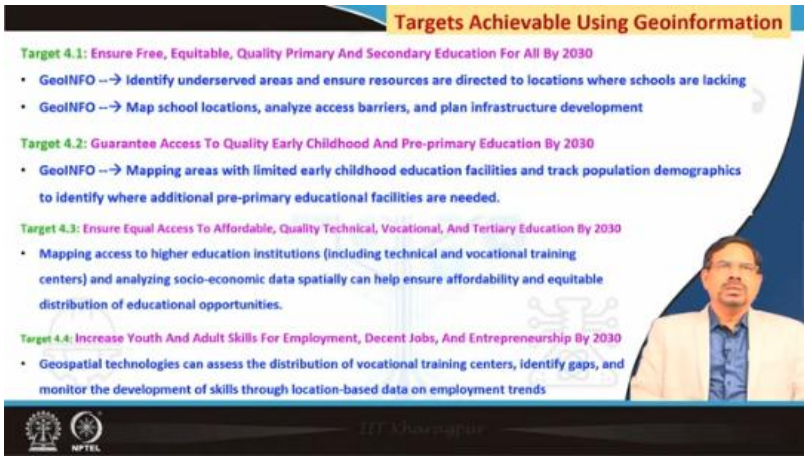


Institutions, school-going children, student-teacher ratios, and school infrastructure. So, this geo-information derived or the information which can be linked or derived using geo-information tools is crucial for decision-making to achieve quality education for all in the mining sector or mining industry sector and its surrounding areas. As far as the global progress towards SDG 4 is concerned, over half of the countries worldwide have achieved or are close to achieving universal primary education according to the target set by UNICEF. Youth literacy rates globally have increased from 83 percent in 1985 to 91 percent in 2013, reflecting the expansion of educational opportunities. So, this poses that means the SDG goal number 4 poses various challenges as far as literacy distribution is concerned in regions like West and Central Africa, where they face significant challenges with very low literacy rates compared to the global average.

This is also true for the mining regions or mining industries, which are most likely located in tribal or other underserved or underdeveloped areas or forest areas. So, that is why the study or the analysis of this and ensuring equitable quality education is a must as far as the sustainable development goal number 4 is concerned. On the right-hand side, we have put the four maps that talk about the literacy rates distribution of the primary, middle school, and adult literacy centers in the district of Bihar as far as the Indian nation is concerned. So, this is given by Kumar et al., published in the study in 2019. So, now let us see the targets that can be achieved using geo-informed technology.

The target 4.1, subsection 4.1, aims at ensuring free, equitable, quality primary and secondary education for all by the end of this decade. So, geo-information helps in the identification of underserved areas and thereby ensures resources are directed to locations where schools are lacking. Geo-information also helps in mapping school locations, analyzing access barriers, and planning infrastructure development. There are several

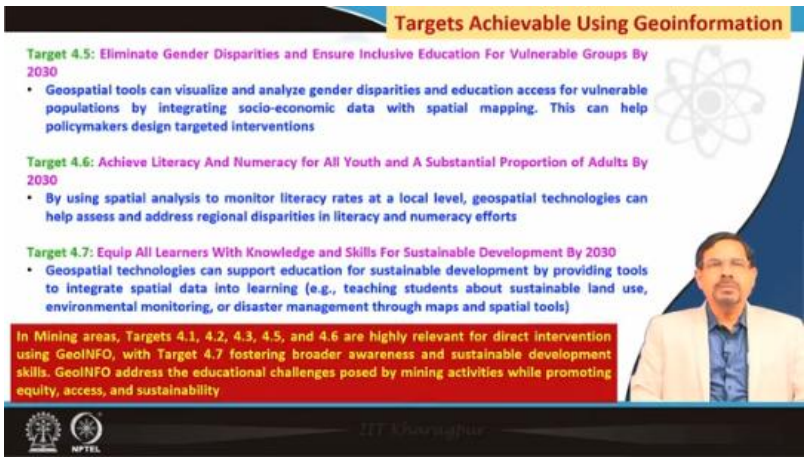
studies and examples in this sector. As far as target 4.2 is concerned, it aims at guaranteeing access to quality early childhood and pre-primary education by 2030.



Geoinformation here helps in mapping areas with limited or early childhood education facilities and track population demographics to identify where additional pre-primary educational facilities are needed. So, target 4.3 aims at ensuring equal access to affordable quality technical vocational and tertiary education by 2030. Thereby helps in mapping this geo information tools helps in mapping access to higher education institution including technical and vocational training centers and analyzing socio economic data spatially that can that means in a X, Y and Z plane that can help ensuring the affordability and equitability as far as the distribution of educational opportunity as concerned in mining sector. So, target 4.4 increase youth and adult skills for empowerment and employment decent jobs and entrepreneurship by 2030. So, this geoinformation technology can access the distribution of vocational training centers identify gaps and monitor the development of skills through location-based data on employment trend.

So, in general as far as target 4.1 to 4.4 these four subsections as concerned geoinformation is mostly useful in terms of giving the locational data or attributing and mapping the locational data. Therefore, can do lot of buffer and proximity analysis and correlate or integrate with many other datasets that helps in giving us pre-informed decision-making process in mining industries. Target 4.5 which aims at eliminating the gender disparities and ensuring inclusive education for vulnerable groups by 2030. The geoinformation tools can visualize and analyze gender disparities and education access for vulnerable population by integrating the socio-economic data with spatial mapping.

So, mostly the integration of socio-economic data with spatial mapping is done using the geo-enforced tool and this is really helpful as far as the policy making design and targeted intervention is concerned in the mining industry sector.



Target 4.6 that aims at achieving literacy and numeracy for all youth and a substantial proportion of adults by 2030. So, by using spatial analysis to monitor literacy rates at a local level. the geo information tool can be useful to access and address the regional disparity in literacy and the numerary efforts. So, this helps in terms of once we once we have a database that that connects in terms of the information the locational information along with the type or the literacy rate whatever information will link to the this as far as the non-spatial or attribute data is concerned.

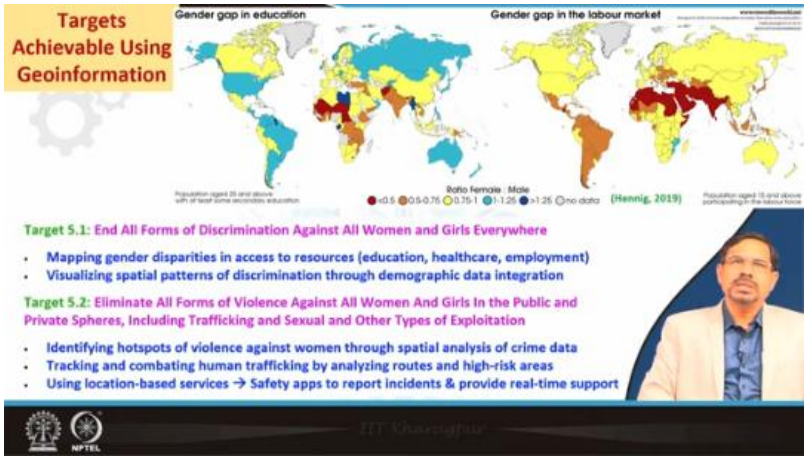
The target 4.7 aims at equipping all learners with knowledge and skills for SDG for sustainable development achievement by 2030. So, here the geo information can support education for sustainable development by providing the tools to again integrate the spatial data into learning suppose let us say the teaching students about sustainable land use or disaster management through map and various kind of spatial tools. So, in totality, in mining areas, target 4.1, 4.2, 4.3, 4.5 and 4.6 are highly relevant for direct intervention using geo-information tools. With target 4.7, fostering broader awareness and sustainable development skills. So, geo-information addresses the educational challenges posed by mining activities while promoting equity, access and sustainability.

So, in in sectors are are various mining industries locations areas all these all these particularly with respect to SDG goal number 4 can be practiced can be developed very well using the geo information platform. Now let us move on to goal number 5 that aims at achieving gender equality and empowerment to all women and girls. So, gender equality role of sustainable development goals and focus areas. As far as the gender

equality is concerned we know that it is a state where access to access and rights to opportunities is should be unaffected by the gender that means equal rights responsibility and opportunities for all genders, recognizing diversity among women and men to be there in every sector including the mining.

So, what are the role? Role in terms of SDGs is concerned, it offers transformational measures to ensure equality for women and girls. advocate for women's economic empowerment as a pathway to equality poverty eradication and inclusive growth. So, what could be the focus areas? Focus areas could be inclusion of women in the economy particularly mining sector.

provision of safe working and public spaces as far as mining industry is concerned, prevention of violent against women and girls as far as mining sector or mining area is concerned and full participation of women in society for community health and prosperity which is also varied as far as the mining industry is concerned. On the right-hand side, we have put a Gender Inequality Index (GII) which is an index for the measurement of gender disparity and these kinds of maps can very well be generated for each mining industry sector using geo information tools. The targets achievable using the geoinformation gender gaps in education, gender gap in the labour market. So, target 5.1, target 5.2 and all forms of discrimination against all women and girls everywhere in that applies to the all the mining areas located across the world. So, geoinformation helps in mapping gender disparity in access to resources such as education, healthcare and employment and also visualizing spatial patterns of discrimination through demographic data integration.

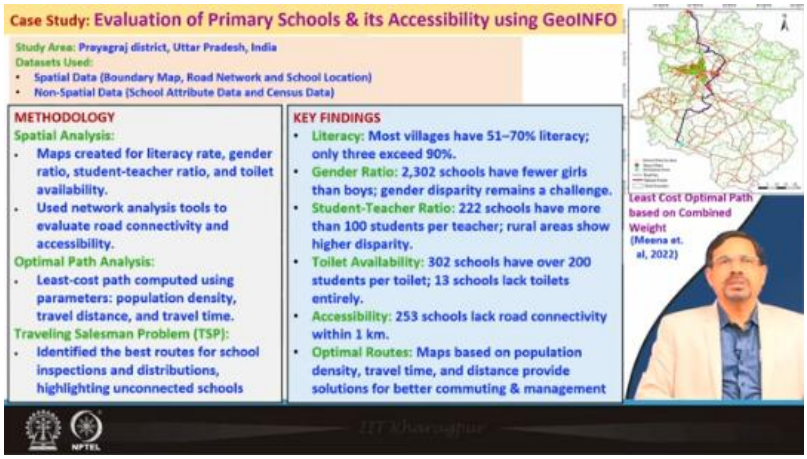


Target 5.2 aims at eliminating all forms of violence against all women and girls. So, let us see as far as the geoinformation based support is concerned, it helps in identifying hotspot of violence against women through spatial analysis and crime data integration in the mining areas and its surrounding. tracking and combating human trafficking by analyzing routes and high-risk areas using geoinformation tools and thereby using this location-based services which helps in safety applications to report incidents and provide a real time support as far as the mining industry or mining sector is concerned. Target 5.3 aims at eliminating all harmful practices such as child, early and forced marriages, marriage and female genital mutilations. So, mapping prevalence of harmful practices by integrating survey and special data is done or can be facilitated using the geoinformation tools.

Identifying regions requiring targeted interventions based on socioeconomic and cultural factors. Target 5.4 that aims at recognizing the value unpaid care and domestic work is benefited from mapping particularly the access to public services infrastructure and social protection programs and also analyzing the spatial equity in service delivery and and

identifying the underserved regions in the mining areas using geo information. So, as far as target 5.5 is concerned that helps or that ensures the women's full and effective participation and equal opportunities for leadership at all levels of decision making. So, geoinformation helps in mapping the representation of women in political, economic and public life across regions and thereby identifying the gaps in participation and areas for policy focus. As far as target 5.6 is concerned, it aims at ensuring universal access to sexual and reproductive health and reproductive rights.

So, geoinformation over mining areas or the mining sector can be useful in mapping access to all these health services, identifying the underserved areas, and thereby tracking the availability of healthcare facilities and their utilization by women. The geoinformation tool can also be useful for monitoring the outreach efforts and effectiveness as far as the reproductive health programs are concerned. So, to summarize, in mining areas, as far as target 5 is concerned, particularly sections 5.2, 5.4, 5.5, and 5.6 can be sufficiently addressed using geoinformation, with targets 5.1 and 5.3 being indirectly supported. So, geoinformation provides insights into spatial inequalities, monitors safety and access to services, and helps design interventions tailored to the unique challenges faced by women and girls. So, let us look at a case study that talks about the evaluation of primary schools and their accessibility using geoinformation tools.



So, this study has been conducted in the Prayagraj district in UP, India. So, the datasets used are various spatial data, particularly boundary maps, road networks, and school locations. This can be similar to the practice for mining areas or the mining industry or the surrounding area of any mining industry. And the non-spatial data can be school attributes data and census data that can be pulled from surveys or from different sources.

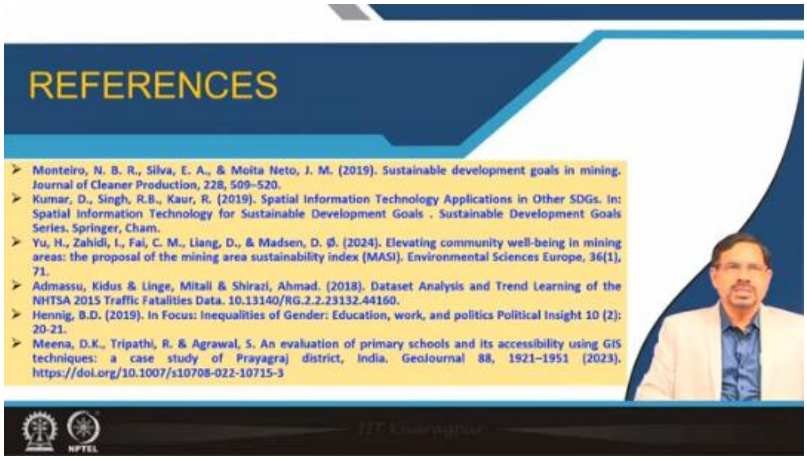
Spatial analysis maps can be created for literacy rate, gender ratio, student-teacher ratio, and toilet availability, which is useful in terms of network analysis tools to evaluate road connectivity and accessibility. Optimal path analysis and least cost path can be computed using parameters such as population density, travel distance, and travel time.

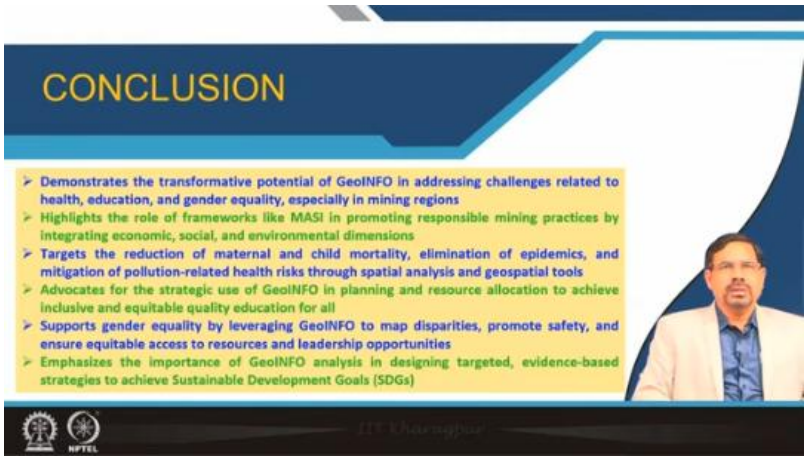
Whereas, the Traveling Salesman Problem (TSP) can identify the best routes for school inspections and distribution, highlighting the unconnected schools. So, here, using the optimal path analysis and the traveling salesman program, the best routes and the areas which are less represented as far as school locations are concerned—or as far as catering to children's education is concerned—can be very well found out. The gap areas can be identified using the optimal path analysis in GIS. So, the key findings. There could be several key findings that have implications in the mining sector, such as literacy, gender ratio, student-teacher ratio, toilet availability, and accessibility as far as schools and road connections are concerned within 1 kilometer or so, whatever conditions we apply, and the optimal routes. So, the optimal routes, which are derived from various maps based on population density, travel time, and distance, provide solutions for better commuting and thereby better management of the mining industry sector as far as the evaluation of education is concerned.

With respect to that, we have several Government of India schemes that are aligned to SDGs 3, 4, and 5, such as Eat Right, National Health Mission, Samagra Shiksha Abhiyan, Sarva Shiksha Abhiyan, Beti Bachao Beti Padhao, and Mahila E-Heart. So, these are the various initiatives as far as the Government of India is concerned, and all of them are applicable to the mining industry sector as an industrial area, as far as the industry is concerned. So, the mining industry has its own defined area and the surrounding area, which also needs to be helped and taken care of through different capacities, as far as the

mining industry is concerned. So, these SDG goals 3, 4, and 5 align well with the Government of India schemes.

Now, with respect to the references, these six references have been used for the preparation of the materials.





And to conclude, the geoinformation and these SDG goals number 3, 4, and 5. The discussion demonstrates the transformative potential of geoinformation in addressing challenges related to health, education, and gender equality, especially in mining regions. This also highlights the role of a framework like MASI, and there are several other indices that help in promoting responsible mining practices by integrating economic, social, and environmental dimensions. So, geoinformation emphasizes through this study and analysis in designing targeted, evidence-based strategies to achieve sustainable development goals, and here in this case, goals number 3, 4, and 5. Thank you very much.