PRIED
Policy Research Institute
for Equitable Development

Alliance for
Climate Justice &
Clean Energy

Project Brief

Health Hazards

A study on the environmental impacts of **coal mining** and **coal-based power generation** in Tharparkar

Acknowledgment

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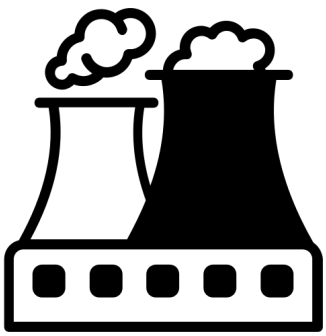
The contents of this brief are based upon data collected from the field, a public opinion survey and anecdotes and case studies shared with the authors by the residents of some selected villages located in various coalfield blocks of Tharparkar district. No laboratory tests and/or collection, collation and analysis of medical records have been carried out as a part of the field work for this brief. Its contents, therefore, should be regarded only as a reflection of public perceptions, personal narratives and situation on the ground.



Background

It is an established fact that economic development based on burning fossil fuels degrades air quality, damages environment and, thus, endangers public health.The World Health Organization (WHO) only reconfirms it when it ranks air pollution as a medical risk just below hypertension, tobacco smoking and high glucose[1] . A 2021 study by the University College London (UCL) also showed that more than eight million people were dying each year across the globe from breathing in the air contaminated by fossil fuels such as coal, oil and gas. Out of these fossil fuels, coal is known to be the deadliest source of air pollution, producing major toxins such as mercury, lead, sulfur oxide, nitrogen oxides, particulate matter and other heavy metals [2] upon combustion. During every stage of its life cycle – i.e. its extraction from mines, transportation, combustion and the dumping of waste water from its mines – it leaves a trail of environmental impacts on host ecologies. While it accounted for more than a quarter of the total global energy mix in 2019[3] , its share in 2021 global carbon emissions, according to International Energy Agency[4] , stood at 40 percent.

External costs of coal mining and coal-based power generation – accrued in the form of underground water contamination, enclosures of local lands, dispossession and displacements of local communities, air pollution and dust – are also making people sick globally. In India alone, at least 76 major coal ash pond accidents have been recorded between 2010 and 2020 in India alone[5] , leading to human deaths, loss of property and extensive environmental pollution. These hazardous effects explain why a modeling analysis done by the Health Environment Alliance (HEAL) predicts that the European countries can save 28 billion euros in public health costs if their coal power plants are retired by 2030 instead of 2050.[6]

All these ominous facts, however, have seemingly failed to stop the use of coal and other fossil fuels. Nearly 77 percent of the global energy needs, for instance, were met through fossil fuels in 2021; coal alone accounting for 25 percent of these needs[7] . The Organization for Economic Co-operation and Development (OECD), an association of the most industrialized states, similarly predicts that the global hunger for fossil fuels will almost double by 2060[8] . Governments in less developed states with weaker environmental regulations are even less likely to put an end to the use of fossil fuels. They routinely collaborate with business concerns to develop fossil fuel assets such as coal mines and power plants. Impacts of these assets are either often ignored or not taken into account while estimating the real cost of extracting and using fossil fuels. To cite just one example, the Centre for Research on Energy and Clean Air (CREA) found in a 2022 study that Indonesia's Environment Impact Assessment (EIA) reports lacked "a quantitative assessment of the health impacts and the toxic deposition impacts" and that these reports applied outdated air pollutant emission standards[9] .

In the case of Pakistan, a CREA study on the coal being mined from Tharparkar estimates that a coal-based

1 https://www.who.int/news-room/feature-stories/detail/air-pollution--the-invisible-health-threat
2 https://www.ucsusa.org/resources/coal-power-impacts
3 https://www.iea.org/reports/world-energy-balances-overview/world
4 https://iea.blob.core.windows.net/assets/c3086240-732b-4f6a-89d7-db01be018f5e/GlobalEnergyReviewCO2Emissionsin2021.pdf
5 https://www.thethirdpole.net/en/climate/coal-ash-is-a-serious-hazard-to-our-health-and-the-environment/
6 https://www.env-health.org/curing-chronic-coal/
7 https://www.visualcapitalist.com/cp/charting-consumption-production-fossil-fuels/#:~:text=In%202021%2C%2077%25%20of%20global,traction%20since%20the%20year%202000.
8 https://www.oecd.org/env/global-material-resources-outlook-to-2060-9789264307452-en.htm
9 https://energyandcleanair.org/publication/health-economic-impact-jambi-1-indonesia/

power generation cluster comprising nine plants (expect to produce a total of 3,700 megawatts of electricity) will turn the district into one of the largest hotspots in South Asia for air pollution, mercury concentration and carbon dioxide emissions. Sulfur dioxide emissions from these plants are also expected to exceed the limits set by WHO, says the study. These emissions alone will impact 100,000 people, it adds. Coal mining and coal-based power plants in Tharparkar, according to CREA, will alsoexpose further 3,000[10] souls to PM2.5 concentrations above WHO permitted levels. Besides these direct health-related costs, coal mining and coal-based power generation in Tharparkar is already degrading the local environment, displacing thousands of human beings and animals from their traditional abodes and grazing lands, disrupting livelihoods at a large scale and exacerbating socio-economic impoverishment of local residents. Other problems arising from coal-related economic activities include crops and soil laden with fly-ash, toxic underground and surface water, stunted births of humans and some animals and unhealthy plants and trees. Yet, all these hazards notwithstanding, Pakistan seeks to quadruple its reliance on coal[11] . Consequently, another power plant with the capacity to produce 1,300 megawatts of electricity is being proposed to be set up in Tharparkar alongside the four power plants – with the combined capacity to generate 2,640 megawatts of electricity – that already exist there. Besides increasing the environmental woes of Tharparkar[12] , These plants will certainly enhance Pakistan's power sector emissions of greenhouse gasses that already constitute two thirds of its total emissions.

The resource curse

Home to nearly two million humans and eight million domestic animals[13], Tharparkar, is a largely agro-pastoral economy with a rich diversity of castes and religions. Life here is a subtle balance between humans and non-humans whereby both consume and replenish each other systematically. Marked by water scarcity, its indigenous livelihood practices have held the local ecology intact for centuries despite recurring droughts. While modern agricultural technologies are now making rapid inroads into Tharparkar, animal power was used here to till the land until very recently.

Tharparkar's typical livelihood cycle comprises four months of agriculture and guided grazing and almost eight months of free grazing and consumption. Major items of consumption are Bajra (millet) and wheat grains, pulses, mushrooms, beans, seeds and more than 15 seasonal vegetables all of which are produced through rain-fed local agriculture. Tharis rely on their animals and dairy products acquired from them to complement their relatively hard but nutritious grain breads. Butter, milk, ghee and drinks based on them like lassi are essential parts of all meals -- from breakfast to lunch to dinner. Grain crops, beans and pulses grown during the monsoon are also important sources of fodder for the animals. They are stored and used until the next post-monsoon harvest. The local population has learned to cope with the dry and arid climate of the Thar desert by developing various techniques to dry foods and dairy products. When those techniques fail – such as during prolonged droughts – Tharis migrate temporarily along with their animals (typically in February-June) to neighboring districts in search of better pastures.

10 https://energyandcleanair.org/wp/wp-content/uploads/2020/05/Thar-Coal-Cluster-Case-Study_Pakistan.pdf
11 www.reuters.com/business/energy/pakistan-plans-quadruple-domestic-coal-fired-power-move-away-gas-2023-02-13/
12 https://www.dawn.com/news/1387909
13 https://www.dawn.com/news/1387909

Coalfields are located in Tharparkar's highly green and vegetated sub-division (taluka) of Islamkot where forest cover on land is rich and the whole area turns verdant after rains. Apart from serving as a source of agriculture, rains also replenish Tharparkar's first aquifer which lies 50 meters under the surface. Water from this aquifer is then retrieved through dug-wells to support life. Animals also serve as beasts of burden to pull water from dug-wells and to transport it, a practice called waara (turn) in the local language. Under this practice, each household uses its animals to draw water from the local well on a fixed schedule. Wells are then left alone for a few hours to replenish before the next household takes its turn.

Tharparkar's combination of agriculture and pastoralism was -- and still is -- partly sustained by a customary land use system. The village commons called gauchers, or community grazing lands, are available for each member of the community. They can use gauchers to graze their animals, plant seasonal vegetables, grow mushrooms and to acquire some other non-timber forest products. Traditionally, no one could harm these lands, use them for non-collective purposes and fell trees existing inside them. A socially sanctioned and environmentally compatible system of land use also protected waterways flowing into particular patches of land. The State, however, is ignoring past practices and the spirit of stewardship enshrined in various statutes and court judgments and is allocating gauchers to coal companies to serve what it calls "the larger public interest".

Admittedly road networks, water supply schemes, socio-economic interventions by non-government organizations and government-run schools and hospitals have been slowly changing Tharparkar's social and economic landscape for the last three decades, Yet, nothing has had more profound socio-economic and environmental impact on the district it than the projects for coal mining and coal-based power generation. These projects are a part of a strategic and economic partnership between Pakistan and China called China Pakistan Economic Corridor (CPEC) which, in turn, is a part of China's global Belt & Road Initiative. The promoters of these projects introduce Tharparkar as an energy hub due to its vast coal reserves. They, therefore, link the district to the rhetoric of energy security and economic progress with slogans like Thar Badleendo Pakistan (Thar will change Pakistan).

Coal extraction and its related activities pollute and brutalize natural resources as well as common lands. Vast areas have been cordoned off by invoking the archaic 'eminent domain' principle that is depriving Thari people of their most valued resource base – that is, their land. This has disrupted the communally organized and managed land-use patterns and caused drastic reduction in grazing lands and animal ownership, as stated in the earlier project brief by Policy Research Institute for Equitable Development on coal-led livelihood disruptions in Tharparkar. Nevertheless, the interventions and technologies of coal mining go deeper than the surface resources. Large-scale open-pit mining to enable coal-based power generation has severely impacted the hydrology of the region[14] , contaminated underground water in the highly water insecure Tharparkar[15] may cause irreversible environmental damages.

14 https://www.priedpk.org/wp-content/uploads/2023/02/Research-Study-Thars-Changing-Hydrology-1.pdf

15 https://pakistan.asia-news.com/en_GB/articles/cnmi_pf/features/2023/04/18/feature-01

Introduction

This project brief is a preliminary exercise to identify and mark environmental impacts being experienced by Tharparkar's human and non-human ecologies in the wake of Thar coal development projects. Geographically, it covers Thar coalfield blocks located in Islamkot taluka of Tharparkar. Given that environment is a broad and complex phenomenon, this brief restricts itself to recording public perceptions of air and dust pollution, impacts on underground water bodies in villages where waste water from coal mining and coal-based power plants is being dumped, anecdotal evidence about the increased incidence of animal and human diseases and the effects of coal ash on various local plants.

Methodology

Our research team -- consisting of one male and one female researcher -- made six visits to as many villages in Thar coalfield blocks. These villages -- Warvai, Jeendu Dars, New Senhri Dars, Gorano, Dhukar Chau and Meghay jo Taar – were selected with a view to cover both Thar Coalfield Block I & Thar Coalfield Block II and because of their proximity to coal mines and power plants. In order to obtain a diversity of opinions, voices and facts on environmental impacts of Thar coalfields, focus group discussions (FGDs) and key informant interviews (KIIs) were used as major tools. The data collected through these tools was then verified with documentary records and visual evidence was also collected where possible. The presence of a female researcher in the research team facilitated the collection of women's views through FGDs and interviews.

The research work included two FGDs of men and one of women in Jeendu Dars, two FDGs in Meghay jo Taar and one in Gorano, a key informant interview in Warvai, a meeting each with a local veterinary doctor, a school teacher and a geologist in Islamkot. A meeting was also held with youth of Warvai village to record their perspective on Thar coalfields and their environmental costs.

Table 1: Population surveyed

Villages name	Number of household	Registered voter	Total population	Location	Number of Villagers working in coal mines and power plants
Jeendu Dars	600	1394	3300	Thar Coalfield Block-II	50
Warvai	520	1430	3000	Thar Coalfield Block-I	105
New Senhri Dars	390	1159	2400	Thar Coalfield Block-I	140
Gorano	590	1538	3800	Near wastewater reservoir	07
Dhukar Chau	210	430	1170	Near wastewater reservoir	15
Meghay jo Taar	850	2734	5100	Near wastewater reinjection plant	60

A brief profile of Thar coal projects

Several coal-based power plants with a combined capacity to produce nearly 6,000 megawatts of electricity are either functioning or are at various stages of installation in Tharparkar's coalfield blocks. Another power plant – with the capacity to generate 1320 megawatts – is also being proposed here. Careful estimates suggest that a 1,000 megawatt coal-based power plant with a supercritical combustion heat rate of 8863 BTU/ kWh[16] and a capacity factor of 80 percent[17] emits 6.30 million tons of carbon dioxide annually. Going by these numbers, the power plants working or being installed in Thar coalfield blocks will cumulatively emit around 38 million tons of carbon dioxide each year. This, however, is a rather conservative calculation given the fact that most of these power plants neither have supercritical combustion rate nor do they have 80 percent capacity factor.

16 https://www.gem.wiki/Estimating_carbon_dioxide_emissions_from_coal_plants#Formula

17 "Capacity factor refers to the difference between power produced and the power that would be produced if the plant is run on rated capacity non-stop. Most plants however, are not run on maximum capacity due to factors like maintenance, fuel availability and demand variation" Ibid.

Table 2: Power plants in Tharparkar

Plant's name	Coalfield Block	Date of commissioning	Capacity (in megawatts)
Shanghai Electric Power Company Limited	I	5th February, 2023	2,660
[18]HUBCO Thar Energy limited (TEL)	II	30th September 2022	1,330
[19]HUBCO Thal-Nova power plant	II	17th February, 2019	1,330
[20]Engro Thar coal power project	II	10th July, 2019	660
Oracle Power[21]	VI	Proposed	1,320

Considering that Pakistan's annual carbon emissions roughly stand at 200 million tons a year and is increasing rapidly at the annual rate of more than 9 percent[22] , these coal-based plants are set to give it a further fillip. Already ranked as the second most polluted country in the world following Bangladesh[23] , Pakistan may soon have the dubious distinction of being on the top of this ranking thanks, in part, to its coal-based power generation. The coal-based power plants can, therefore, inflict horrible public health losses – not only in Tharparkar but across the whole of Pakistan.

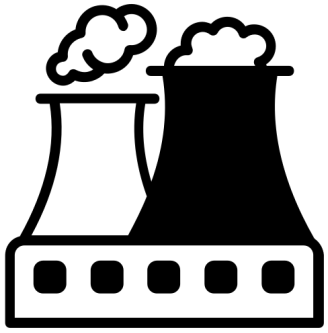
18 https://cpec.gov.pk/project-details/73
19 https://cpec.gov.pk/project-details/90
20 https://cpec.gov.pk/project-details/3
21 https://www.thethirdpole.net/en/energy/ambitious-solar-project-to-join-string-of-coal-plants-in-pakistans-thar-district/
22 https://www.worldometers.info/co2-emissions/pakistan-co2-emissions/
23 https://energyandcleanair.org/publication/air-quality-health-and-toxics-impacts-of-the-proposed-coal-mining-and-power-cluster-in-thar-pakistan/

Public health impacts of coal-led environmental pollution

Coal-based power plants emit pollution in four main ways: i) as fly ash from their smokestack; (ii) as residue ash which subsides at the bottom after the coal is burnt; (iii) as gasses released by scrubber units (which perform chemical processes for the removal of some pollutants); and (iv) as gas released into the air. With the development and expansion of coal mining and coal-based power generation in Tharparkar since 2013, strong air pollution, therefore, is being reported in several villages located around mines and power plants – particularly because of fly ash and mine dust.

Here it must be stated that this pollution does not impact everyone in the same manner. Different people, indeed, are affected differently by the same levels of pollution because of differences in age, gender, immunity level, diet and other medical factors. Similarly, some industrial emissions may not be harmful on their own but become dangerous after mixing with water, air and food chains. Third, the atmosphere is a major conduit for toxins and pollutants. When coal ash and dust come into contact with high velocity wind and low humidity, this impacts their direction as well as the degree of their diffusion. This means that the pollution created by Thar Coalfield Blocks may not remain concentrated in Tharparkar but could travel far and wide.

These qualifications, however, should be no reason to ignore the known medical impacts of hazards emissions from coal mining and coal-based power generation. These impacts include skin diseases, cardiovascular ailments, illnesses related to the brain, blood and lungs and different cancers. The emission of carbon dioxide during power generation changes the air quality when it mixes particulate matter (PM 2.5) and leads to increased asthma attacks and other respiratory diseases. The ash residue of coal combustion contains toxic elements such as mercury, lead, sulfur and over a dozen heavy metals which can cause birth defects, loss of livestock, degradation of biodiversity and soil erosion. Nitrogen oxides released into the air because of the burning of coal cause smog and acid rains. While acid rains were seen in Tharparkar in 2022, smog is also becoming a significant and persistent problem here, especially in winters.



‘I never wanted to leave my village but I could not breathe there.’

Haji Sanullah Rahimoo, an old man living in Jeendu Dars, says: We the people of Tharparkar are very healthy. This is because our air is fresh and free from toxins, our vegetables grow in fresh air and we consume bajra, butter and fresh milk.” But, he says, “we are losing our way of life now” because the companies involved in coal mining and coal-based power generation “are spreading poison through the air”.

He describes how, when wind blows every morning, “a fine layer of coal ash covers roads, our houses and plants”. If this continues the same way a few more years, he says, “we will be half dead because this ash will start flowing with our blood within our bodies.”

Allah Dino Jourio, a 60-year-old school teacher who once lived in Warvai, also laments the many problems that coal mining and coal-based power generation has been brought to his village. After coal was discovered in our land, he says, “the landscape of my village has changed and all colours of life are now converted into grey and black”.

He describes how living close to the coal mining area is “putting our lives in jeopardy”. Every mornings, he says, “the village is covered in a dusty, putrid haze and the grey ash lingers over houses, courtyards and trees”. He is particularly concerned about the large stockpile of coal lying next to his village. “Strong winds carry ash from this pile into the village, plaguing everyone who happens to be outdoors,” he says. Local people “cannot even stay indoors with open windows and doors”.

He himself contracted vomiting and asthma. “It was not sudden,” he says. “First, I felt a shortened breath which used to wake me up in the middle of the night. This kept getting worse, making it difficult for me to breathe at all. Sometimes my children had to take me to my sister’s home in another village so that I could breathe.”

He consulted many doctors but his condition did not improve. Two years ago, he left his village to live alone in Islamkot because his seven sons and three

daughters still live there with their mother. “I never wanted to leave,” he says, but “I couldn’t breathe there. “It was a hard decision to leave my home. It was here that I was born and spent 55 years of my life,” he says.

Table 3: Types of pollution

Serial number	Village	Pollutants
1	Gorano	Wastewater from mining TCB-II
2	Dhukar Chau	Wastewater from mining TCB-II
3	Khario Ghulam Shah	Mining dust TCB-I
4	Tilwayo	Mining dust TCB-I, Chimney smoke from coal power plant TCB-I
5	New Senhri Dars	Mining dust, Chimney smoke from coal thermal power plant TCB-I
6	Vakrio	Coal ash from coal coal stockpile, Mining dust TCB-II, Smoke and pollution from Coal Filter Plugging Point
7	Jeendu Dars	Coal ash, Chimney smoke from TCB-II, Coal mining dust from TCB-II
8	Bhave jo Taar	Chimney smoke from TCB-I
9	Warvai	Mining dust, Fly Coal ash from coal crushing, Coal ash from coal stockpile
10	Bitra	Smoke and pollution from Coal Filter Plugging Point, TCB-II
11	Jaman Samoo	Smoke and pollution from Coal Filter Plugging Point
12	Aban jo Taar	chimney smoke from coal power plant TCB-II

Our field survey found ample evidence of these impacts. It shows that respiratory ailments such as shortness of breath, asthma and cough had a higher incidence in Jeendu Dars -- located just three kilometers from coal mines and five kilometers from a power plant -- than in Thario Halephoto, Pabuhar and Besao villages which are located further away. People reported health issues like cough, and shortness of breath. Residents of Jeendu Dars report that every household in their village always keeps cough syrup for immediate relief. This, they say, was never the case before the advent of coal mining.

Residents of Warvai are facing an even more dangerous situation because power generation companies have started storing used coal a few hundred meters from their village. This stockpile of coal is spread over 2,500 acres which house 20,000 tons of coal. It is so big and tall that the villagers can see it from their homes and routinely breathe and smell its sulphur content. Everyday trucks bring coal from the nearby power plant and dump it in the stockpile.

Though these trucks are usually covered with cloth, this cover does little to stop coal dust from polluting the surrounding air. The stockpile itself is also a source of fine particulate matter that is released in the air either by winds or during the transportation of coal. Though some of its negative impacts can be minimized, according to experts, by spraying it with water or any topper agent, local residents report that they have not seen any such measures being taken. . The coal stored here runs another risk too: of catching fire if and when it comes in contact with oxygen. Local residents, however, report that no safety measures have been taken to protect their homes and hearths from such an accident.

Air pollution is also reported to be causing severe respiratory problems such as asthma in Warvai -- especially affecting children below 12 years of age and older people aged more than 45 years. Why children are suffering more is because 1) they breathe faster than adults; 2) their lungs and other organs are not mature enough to withstand external pressures; and 3) the barrier between their bloodstream and brain is not fully formed.

‘I am always worried about the future of my children.’

Air, water and noise pollution is reported to be hurting women residing in the villages close to Thar Coalfield Blocks more than it is hurting men in the same area. Most of them exhibit fears relating to physical weakness, blood pressure and anxiety in general – more than men do. They also talk of giving premature births, experiencing decreased birth rates and facing increased incidence of neonatal and maternal health problems with their newborns suffering from previously unheard of congenital abnormalities. They report comparatively more skin problems too. Exposed parts of their body – such as arms, hands and faces -- are relatively more affected from ash than those of men since they have to spend large amounts of time working in the fields and fetching water from wells.

Tuggo problems illustrate that it is not just their own health that keeps local women anxious about themselves and their families. She lives with her husband Chetan and nine children in a humble, impoverished house in Jeendu Dars where she was born 58 years ago. She lives only three or so kilometers away from a coal mining site and the monstrous mounds of earth lying beside the mine can be seen from her house. “We are always breathing in coal dust and grey ash but we have no other option except to live in this house that we have built ourselves,” she says. This situation, according to her, gets worse dust during the summers. “Occasionally, we also experience foul smells [emanating from the mine’s acidic water],” she says.

Tuggo is, therefore, “always worried about the health and the future” of her children. Her three sons working in the coal mining are all suffering from chest infections and frequently need to visit local hospitals to get treated. They, however, cannot leave their jobs because, as she puts it, “we don’t have any other means of livelihood”. Her 28-year-old son Dolat has been working in the coal mine for four years. Nowadays, he is unable to breathe easily. Yet, he still has to go to work in the same dust-filled site which has made him sick in the first place.

His income is also so meager that he cannot afford to get a proper treatment. “The mining companies do not help poor workers even though they had promised to do so before implementing the project,” she says, ” wiping tears.

Table 4: Public health impacts of coal-caused pollution in Tharparkar villages

Village	Diseases	Children (aged 0-12)	Adults (aged 12-45)	Old (aged 45 plus)	Women	Total
Jeendu Dars	Cough	70	15	56	28	169
	Respiratory diseases	25	8	102	45	180
	Weakness	0	0	76	12	88
	Itching	85	18	10	38	151
	Cough	310	120	450	150	1030
Warvai	Asthma	58	30	60	30	178
	Itching	25	8	120	70	223
	Cough	130	80	120	80	410
New Senhri Dars	Respiratory diseases	29	18	30	60	137
	Weakness	30	12	50	90	182
	Itching	60	36	79	60	235
Grand Total		822	345	1153	663	2983

The survey team, similarly, found that the presence of dust in villages around power plants is particularly high between early December and early June even when strong winds blowing across Tharparkar carry this dust either to the sea or to further inland – depending on changes in their direction with changes in weather. Five villages -- Verwai, New Senhari Dars, Bitra, Aban jo Tar and Vakrio -- fall in the direct range of this coal dust. Local residents complain that a sulphuric odour persists in their environment and there is always dust on the floors of their houses, utensils and food.

Power plants, in fact, have no emission control equipment except the height of their smokestacks which is assumed to be enough to disperse pollution far and wide.

It is, therefore, not surprising that many people in Jeendu Dars, New Senhri Dars and Warvai perceive the impacts of this pollution on human and animal health and environment to be negative: More than 15 percent of the people surveyed - fear loss of their livestock, another 10 percent are worried about the loss of biodiversity and trees and 65 percent show concern about human and animal health.

Coal-induced water woes

Staggering amounts of water are being exploited and polluted during coal mining and coal-based power generation in Tharparkar. In this already water-scarce region, this additional consumption and contamination of its water resources is posing serious challenges to its people. Thar coal projects are, in fact, profoundly changing the water profile of not just Tharparkar but its neighboring districts as well because 200[24] cusecs from the Nara Canal system are being diverted to these projects at the expense of farmers in Umerkot and Mirpurkhas districts. Mining operations are also contaminating Tharparkar's surface and ground water through acid drainage, leakage from wastewater reservoirs and direct injection of wastewater into the ground. This contamination will certainly leave pollution legacies that will persist decades after coal mining operations have ceased.

To cite the most ominous example of this water contamination, brine subsoil water being pumped of coal mines in Thar Coalfield Block II is being dumped since 2016 in a vast reservoir set up near Gorano village[25]. This water is called Acidic Mine Drainage (AMD) and contains a very high amount of some medically hazardous metals. Its presence in the reservoir is, therefore, leading to an abnormal of these metals in its water.

The reservoir is also gradually polluting soil and underground water resources in 12[26] nearby villages. Consequently, around 6,000 Kandi trees are now standing dead within the reservoir and as many as 40 local dug-wells have been contaminated. These wells were once known to contain abundant sweet water because, being located along a natural depression, they were annually replenished by seasonal rains.

In the event of heavy rains, the reservoir runs the risk of overflowing and inundating nearby villages of Suleman Hajam, Chhote ji Dhani and Alle ji Dhani with its contaminated water. Already around 16 households of Alle jI Dhani have been resettled because of the reservoir's overflow while its dampness seeping into the ground has damaged walls of numerous buildings -- including houses, shops, temples and mosques -- in the villages of Kattan, Guwaran, Suleman Hajam, Chhote ji Dhani, Alle ji Dhani and Phote ji Dhani.

Similarly, wastewater being re-injected into the ground at Meghay jo Taar occasionally overflows and floods neighboring villages. This water is being generated during the process of washing coal and contains hazardous solids, chemical oxygen demand (COD) and metals but the companies involved in mining and power generation provide the local residents with no information about its quantity and the quality.

Water contamination is also having seriously negative medical impacts on the local population. For instance, more than five cases of cancer have been reported in Meghe jo Taar alone. Knee pain is widespread among the elderly living in the villages surveyed while several villages in Thar Coalfield Block-II have reported cases of premature births which were unheard of before. Many others also complain of other pregnancy-related problems and stunted growth among children.

Water samples collected in June 2022 (before the start of monsoon season) from various villages located in Thar Coalfield Block I and Thar Coalfield Block II and analyzed by the Mehran University of Engineering and Technology showed excessive quantities of chloride, total dissolved solids, mercury and lead. Excessive fluoride was also found in eight samples and arsenic was reported to be present in four of them. Arsenic and selenium

24 https://epa.sindh.gov.pk/files/EPA-Sindh/EIA-IEE/EIA%20MFLCP%20%28Draft%29%20V1.2%2019052022%2021-11-2022.pdf

25 https://www.priedpk.org/wp-content/uploads/2022/02/Project-Brief-Coal-Power-Project-Poisoning-Water-in-Thar.pdf

26 https://www.dawn.com/news/1314947

found in these samples too exceeded the limits set by WHO though they fall within the standards of the Sindh Environmental Protection Agency (SEPA).

Effects of the contaminated groundwater seepage are visible on local trees as well. The most eminently impacted tree is neem (nimba, the miracle tree). It is one of the oldest and most celebrated indigenous trees in Tharparkar because it grows both tall and wide and its evergreen leaves provide much-needed shade to human beings and animals in the desert's scorching heat. It is now suffering from a disease that causes it to shed its leaves all year round. Even though it is difficult to establish a causal connection between its disease and the degradation of groundwater caused by coal mining and coal-based power generation, there is certainly some kind of a correlation between the two because, just as the locals testify, neem has been never before seen to shed its leaves – except in autumn.

Coal-caused soil erosion and land degradation

Villagers in Gorano report that their land has become softer and, therefore, cannot support trees and healthy plants. While such anecdotal evidence abounds about the degradation of local soil, the concerned government departments have conducted no inquiry into the problem in order to gauge its extent and impacts. Our survey found that crops grown on the degraded soil are less productive than those being grown on normal fields. Local residents say production of bajra (millet), jawar, cluster bean, mung, mothe and sesame has dropped by as much as 50 percent in the villages around Gorano reservoir in recent years. They say that the crop productivity has declined due to the declining soil fertility, making it unsuitable for agriculture. Soil degradation is also affecting human health as it helps pollutants to seep easily into food chains through plants, grains and crops grown on it.

Agricultural lands in villages around coal mines are also deteriorating. Here is how a resident of Jeendu Dars explains this deterioration: since the earth extracted during mining activity and stored outside the mine creates slope structure extraneous to natural local geography, this changes how rain interacts with land. It gets mixed with earth and stones extracted from the mine and forms mud sediments that slowly colonize the erstwhile arable lands and render it infertile.

Since soil around Gorano reservoir has been degraded because of high levels of salinity, this has reduced the growth of many locally important plants such as kandi, khip, jaar and rohiro. While some of these plants – particularly kandi – offer food in the dry season, others – such as khip -- are used as camel fodder and for building homes and firing cooking stoves. In Gorano and Dhukar Chou, grasses, shrubs and bush are also affected badly.

Air pollution and livestock

Livestock is also experiencing the adverse effects of a cocktail of contaminants in air and water. In the last six months alone, around 63 sheep, 24 cows and 73 goats have died after they consumed toxic water in Maghay jo Taar, Bitra, khario Ghulam Shah, Paro jo Taar and Jaman Samoo villages.

The main reasons for these deaths are food poisoning, cough, lassitude and diarrhea. As a local veterinarian puts it, these ailments are being caused by fly ash which pollutes the environment all around the power plants – including pasture lands.

Table 5: Animal deaths due to diseases in Thar Coalfield Blocks

Village	Cause of death	Sheep	Goats	Cows	Camel	Total
Jeendu Dars	Food poison	6	13	2	1	22
	Cough	9	7	4	0	20
	Diarrhea	10	33	3	0	46
Warvai	Cough	15	26	7	1	49
	Food poison	5	3	2	1	11
New Senhri Dars	Cough	5	9	0	1	15
	Food poison	3	2	0	0	5
Total		53	93	18	4	336

Nausea in the land of peacocks

Bad odour is caused by a mixture of gasses released in the air during coal mining, smells arising from wastewater and smoke emitting from coal-fired power plants. Residents of Jeendu Dars say the largest source of an unbearable stench for them is a wastewater pond -- called buffer zone – within the mining area of Thar Coalfield Block II. Located around 2.5 kilometers from the village, this fenced pond is routinely monitored by security personnel and, according to local residents, is causing the increased incidence of malaria among them. They say mosquitoes breeding in this pond invade their village from September to March, making them sick and hampering them from having a sound sleep. Residents of Warvai have a similar complaint. They say that the stockpile of used coal near their village stinks so much that it often causes nausea and vomiting to them.

Noise is another form of pollution that the communities living around power plants have to endure. Many of them say that they always have disturbed sleep because of this noise. Before the advent of these industrial units, night time silence across Tharparkar villages was broken only by the buzz of insects, cooing of peacocks, mooing cows and bleating of sheep – all part of their millennia-old lived experience. Now they have to contend increasingly with such novel noises as the engine sounds of dumper trucks whizzing by, cranes and diggers clanking and electricity turbines rotating at a deafening and earthshaking speed.

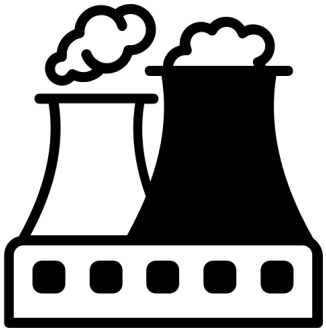
New Senhri Dars is in the immediate vicinity of the coal power plant in TCB-I. The noise caused by cranes and nearly 1200 trucks per day colonizes the sound escape. Communities' exposure to power plant noise is high during the night time. They further informed that they used to live in peace before resettlement. After being relocated near the power plant they cannot sleep well because of bulldozers that traffic throughout the night. Those living in Warvai endure this noise every morning when more than 220 trucks loaded with coal pass in front of houses and villages between 4:00 am to 8:00 am to dump used coal in the stockpile.

People living in Jeendu Dars complain of sleep-deprivation, anxiety and sickness due to the noises coming from the nearby coal mines. Though they have raised these problems several times in front of the management of mining companies, no steps have been taken to ameliorate their plight.

Recommendations

Based on observation and data collected on the impacts of coal mining and coal-based power generation in Tharparkar, we recommend the following:

- Proper accounting of the costs to animal and human health should be made by relevant government entities; these costs should be included in the cost of electricity being generated from Thar
- Hospital and veterinary treatment facilities should be made readily available in villages around coal mines and power plants; affordable and reliable healthcare should be ensured at these facilities
- Studies should be conducted to ascertain the nature, extent and cost of impacts that coal ash and dust are having on crops, soil and its fertility, vegetation, trees, plants and bush.
- Any new coal-based power plant and coal mine development must take account its potential medical, agricultural and environmental costs; arrangements should also be made for the mitigation and compensation of such costs prior to the project development
- Surface and water resources of Tharparkar must be safeguarded from the negative impacts of coal mining and coal-based power generation
- (Sindh Environment Protection Authority (SEPA) must come up with stringent environmental regulations to save local people from the actual and potential harms caused by coal mining and coal-based power generation.



Annex 1: National and international environmental regulations and policies

Legal, Regulatory, and Policy Frameworks		
Dimensions	National	International
Air and noise	Pakistan Environmental Protection Act 1997; Pakistan Environmental Protection Agency Review of Initial Environmental Examination and Environmental Impact Assessment Regulations 2000	
Waste disposal	Explosives Act 1884; Self-Monitoring and Reporting(SMART) by Industry Rules 2001; Factories Act 1934; Factories Rules; Hazardous Occupations Rules 1963;	International Convention on Oil Pollution Preparedness, Response and Co-operation. Stockholm Convention on Persistent Organic Pollutants. Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal.
Biodiversity	Sindh Wildlife Protection Ordinance 1974; Forest Act 1927; Pakistan Environmental Protection Act 1997; Pakistan Environmental Protection Agency Review of Initial Environmental Examination and Environmental Impact Assessment Regulations 2000	Convention on Biological Diversity covering ecosystems, species, and genetic resources and also the field of biotechnology; Cartagena Protocol on Biosafety to the Convention on Biological Diversity; Bonn Convention on the Conservation of Migratory Species of Wild Animals; Memorandum of Understanding concerning Conservation Measures for the Siberian Crane; Convention on International Trade in Endangered Species of Wild Fauna and Flora; International Plant Protection Convention (1997); Agreement for the Establishment of the Near East Plant Protection Organization; Plant Protection Agreement for the Asia and Pacific Region and amendments.

Annex 2: Hazards caused by various pollutants

S#	Pollutants	Human health hazards	Environmental hazards	Findings by the Center for Research on Energy and Clean Air (CREA)
01	Acid Gases	Irritation to skin, eye, nose, throat, breathing passages.	Acid precipitation, damage to crops and forests.	1. The plants would emit an estimated 1,400 kg of mercury per year, of which one fifth would be deposited into land ecosystems in the region. 2. The air pollutant emissions from the plants and mines would expose an estimated 100,000 people to exceedances of the World Health Organization guideline for 24-hour average sulphur dioxide concentrations and 3,000 people to exceedances of the guidelines for 24-hour average PM2.5 concentrations. 3. The power plants and mines would be responsible for a projected 29,000 (95% confidence interval: 22,000-37,000) air pollution-related deaths over an operating life of 30 years. Other health impacts include 40,000 asthma emergency room visits, 19,900 new cases of asthma in children, 32,000 preterm births, 20 million days of work absence (sick leave) and 57,000 years lived with disability related to chronic obstructive pulmonary disease, diabetes and stroke. 4. Deaths of small children from lower respiratory infections linked to PM2.5 pollution from fossil fuels was assessed using the Global Burden of Disease risk function for lower respiratory diseases (GBD 2017)
02	Mercury	Damage to brain, nervous system, kidneys and liver. Causes neurological and developmental birth defects.	Taken up by fish and wildlife. Accumulates in the food chain.	
03	Arsenic, beryllium, cadmium, chromium nickel, selenium, manganese	Carcinogens: lung, bladder, kidney, skin. May adversely affect nervous, cardiovascular, dermal, respiratory and immune systems.	Accumulates in soil and sediments. Soluble forms may contaminate water systems.	

04	Lead	Damages the developing nervous system, may adversely affect learning, memory, and behavior. May cause cardiovascular and kidney effects, anemia, and weakness of ankles, wrists and fingers.	Harms plants and wildlife; accumulates in soils and sediments. May adversely affect land and water ecosystems.	
05	PM2.5	Deaths of small children from lower respiratory infections		
06	Particulate matter	Asthma attacks, heart rate variability, heart attacks.		

Annex 3: Toxic materials found in Tharparkar's water resources

Sources of water sample	Pollutant	Compared to WHO standards	Compared to SEPA Standards
Khario Ghulam Shah village dug well	Lead	610 percent higher	42 percent higher
	Mercury	5900 percent higher	5900 percent higher
Jaman Samoo village dug-well	Lead	750 percent higher	50 percent higher
	Mercury	1800 percent higher	1800 percent higher
	Arsenic	160 percent higher	Does not exceed the limit
Amra well, Bitra	Lead	690 percent higher	58 percent higher
	Mercury	4600 percent higher	4600 percent higher
Paro jo Taar water tank	Lead	290 percent higher	Does not exceed the limit
	Mercury	1800 percent higher	1800 percent higher
	Arsenic	At the cusp of the limit	Does not exceed the limit
	Selenium	At the cusp of the limit	At the cusp of the limit

Meghay jo Taar water pipeline	Lead	3200 percent higher	560 percent higher
	Mercury	9400 percent higher	9400 percent higher
	Arsenic	150 percent higher	1.8 times higher than the recommended limit
	Selenium	1900 percent higher	1900 percent higher
Meghay jo Taar water tank	Lead	1400% higher	200 percent higher
	Mercury	9300 percent higher	9300 percent higher
	Arsenic	150 percent higher	Does not exceed the limit
	Selenium	620 percent higher	620 percent higher
	Chromium	36 percent higher	36 percent higher