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Do Negative Environmental Externalities Cause Resistance Against Land Acquisition? Experience of Mining Districts in Odisha

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Abstract

Increasing protests against land acquisition in India in recent times have resulted in an impasse of various development initiatives. The situation appears to be far grimmer in the states like Odisha, where large scale land acquisition is required for implementation of various industrial projects including mining, but severe protests by different stakeholders have caused the state of acquisition to be abysmally gloomy. Resistance against land acquisition, particularly for mining is in sharp contrast to the commonly perceived notion that mining results in socio-economic development in the mineral-rich economies. While the existing studies in general have attempted to analyze such dichotomy in terms of the mode of acquisition, amount of compensation, possible rehabilitation and resettlement of the displaced people and others at the local level, the issues relating to depletion of natural resources and environmental degradation have remained largely unexplored. The present paper is an attempt to fill in this gap. Analyzing secondary data the paper finds that while, mining has failed to provide any significant boost to the society, it resulted in water pollution along with decrease in ground water level posing threat on sustainability of the development process and raising incidences of death due to water-borne diseases. The incidences of death caused by air-borne diseases are also quite high in the mining districts of the state. The findings of the present paper, therefore, suggest that the proposed 'Land Acquisition and Rehabilitation and Resettlement Bill' should have enough provision to address these negative environmental externalities of mining. In addition, appropriate laws should be enacted with necessary regulatory framework to guide the investors in performing their environmental responsibilities.

Key Words: Mining, land acquisition, environment, negative externalities, Odisha

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Do Negative Environmental Externalities Cause Resistance Against Land Acquisition? Experience of Mining Districts in Odisha

Introduction

While importance of land in providing livelihood opportunities, individual identity, and a sense of security to its owners, apart from the asset value, is well-recognized, changes in ownership (i.e., property rights) and form are imperative in the process of economic transition. In many cases, such changes lead to conflicts of interests across various stakeholders[3]. This has been reflected in recent attempts towards land acquisition that have encountered severe protests across the country resulting in an impasse of various development initiatives[4]. In general, resistance against land acquisition is expected to have serious adverse impact on overall development of an economy along with aggravation of social tensions.

The consequence is likely to be far grimmer in the Indian state of Odisha that is facing stiff protests against land acquisition for the proposed mining and mining-based projects. It is observed that the state has signed as many as 89 Memorandum of Understandings with different industrial houses between 2002 and 2009 and out of that 49 are with the steel producing industries (IDCO Odisha, 2012). Since iron ore and coal are the basic ingredients in the production of steel and their reserve in the state in relation to the country's total reserves is very high[5], implementation of these proposed steel projects necessitates large scale mining and hence acquisition of land for the same[6]. Besides, Odisha contributes considerably to the country's total stock and exports of minerals. Contrary to this, the proportion of land acquired for mining so far has been abysmally low in the sector (Mishra and Mishra, 2012). The proportion of land acquired for the on-going mining projects is only 35.78 percent of total land required, and when

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[3] The nature and the extent of transformation may, however, vary depending on the path of economic transition.

[4]Peoples' resistance against land acquisition at Jagatsinghpur, Kalinganagar, Lanjigarh, Kashipur, Gajamara, Darlipali, Angul, Kendujhar, Khandadhar, and Puri in Odisha; at Khunti, Khunti-Gumla, Bokaro, East-Singhbhum, Sareikela-Kharasawan, Jamshedpur, Dumka, and Karnpura in Jharkhand; at Jhanjgir Champa district, Dharamjaigarh, and Jashpur in Chhattisgarh; at Nandigram and Singur in West Bengal; at Guntur in Andhra Pradesh; Mughalsarai, Bhatta–Parsaul, and Dadri in western Uttar Pradesh; at Kuduthini, Haraginadoni, Mandakalli and Mysore in Karnataka, are some such major incidences of conflicts of interests of the land owners vis-à-vis the investors and the state. Land owners' protests against acquisition have also been observed in other parts of the country such as at Gobindpura in Punjab, Gorakhpur in Haryana, Sanand in Gujarat, Jaitapur in Maharashtra, Palakkad in Kerala and Chennai in Tamil Nadu, aggravating the problem further.

[5]Odisha accounts for 25.82 percent, 32.53 percent, and 56.36 percent of India's total reserves of coal, iron ore and bauxite respectively (Government of Odisha, 2011-12).

[6]This is so because mining has become a major economic activity in the state that contributes significantly in terms of its share in GSDP, royalty, value of exports, tax revenue, etc. (Mishra and Mishra, 2012).

all the mining and mining-based development projects are taken together, it is 34.47 percent (IDCO Odisha, 2012)[7].

Resistance against acquisition of farmland, particularly for mining, is in sharp contrast to the commonly perceived notion that mining results in socio-economic-human development of mineral-rich economies (Ejdemo and Soderholm, 2011; Hazkowics et al., 2011; Fisher et al., 2009)[8]. In general, mining can generate wealth, create large-scale employment (Ejdemo and Soderholm, 2011), improve infrastructure, provide raw materials for the related industries, aid to reach energy and resource efficiency targets (MMSD, 2002), contribute to world production and trade (Shen et al., 2009), address poverty (Fisher et al., 2009; Davis and Tilton, 2005), and foster economic growth and development (Aroca, 2001). There exist numerous evidences where mining projects have facilitated development of the local economies through generation of employment and enhancement of economic well-being (Ejdemo and Soderholm, 2011; McMohan and Remy, 2001; Stilwell et al., 2000; Ye, 2008; Clements et al., 1996; Brunnschweiler, 2006). Mining projects also create non-mining related employment opportunities that are often more than direct employment generated by new mines (Ejdemo and Soderholm, 2011; McMohan and Remy, 2001). However, acquisition of land and subsequent displacement are imperative while reaping the potential benefits of mining leading to conflicts of interests across the stakeholders.

Given these potential developmental outcomes, the important question is therefore why the state of land acquisition for mining and mining-based industries has been so dismal in Odisha, particularly when mining has the potential of bringing in socio-economic-human development? Attempts have been made (e.g., Mishra and Hota, 2011) to understand peoples' protests against acquisition of land in terms of its developmental outcomes. But, the bigger issue perhaps is not peoples' perception about the developmental outcomes of mining, rather their skepticism regarding efficiency of the existing institutions in delivering the benefits at the local level, and sustainability of the mining-led development process. It is observed that efforts towards mining have affected the local ecology and livelihood of the forest dependent communities adversely (Government of Odisha, 2012). In addition to the detrimental effects on land use pattern and deterioration of agriculture and forest cover[9], extension in coal fields and industrialization have

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[7] Protests against land acquisition in India are not isolated cases. Many other developing countries in the world such as China, Malaysia, Peru, etc. have also struggled in meeting the land requirements for expansion of the mining and mining-based projects due to increasing social conflicts and mobilization against land acquisition.

[8] Resistance against land acquisition for mining is also in sharp contrast to the models of economic development which essentially propound that a transition from the primary sector to the modern sector benefits both the sectors and thereby facilitates overall development of the economy (Matsuyama, 1992; Lewis, 1954).

[9] Singh et al., (2010) finds that the areas under forest cover, agricultural land and water bodies in the Angul-Talcher region of Odisha have decreased steadily over the last three decades with the areas under settlements/industries and barren land showing an increasing trend.

resulted in degradation of natural resources, pollution in different forms, contamination of water bodies (CSE, 2008)[10], and human health hazards (Vasundhara, 2008-09).

While mobilizations against land acquisition for mining have resulted in debates in academics, policy formulation, legislation and social movements[11], majority of the recent studies, particularly in Indian context, have emphasized on designing appropriate pricing structure of land and other compensations to facilitate land acquisition. (e.g., Marjit, 2011; Ghatak and Ghosh 2011; Bardhan, 2011; Dutta, 2011; Sarkar, 2007). The other major issues addressed in the literature include property rights and transaction costs (Sarkar, 2007), displacement, rehabilitation and resettlement, benefit sharing (Cernea, 2007; Fernandez, 2007), scope for judiciary reforms (Rath, 2007), and role of the state in acquisition process (Dutta, 2011; Sarkar, 2007). Although some of the existing studies have dealt with depletion of non-renewable resources, carbon emission, and climate change following land acquisition (e.g., CSE, 2008; Jena, 2008; Chaulia, 2003)[12], the issues addressed are largely general and perception oriented in nature. Given that mining requires land acquisition at a larger scale along with displacement and/or deforestation, the consequences in terms of depletion of natural resources, environmental degradation and consequent loss of livelihood at the local level are likely to be more critical as compared to what is commonly perceived in the existing studies.

The present paper is an attempt to address these issues. In other words, the objective of the present paper is to understand the environmental consequences of mining in Odisha. The necessity of such an attempt arises not only because Odisha relies heavily on mining for generating revenue, but also for its backwardness in terms of poverty and human development (Thorat et al., 2007). Owing to the huge stock of mineral resources, mining and mining based industries in these districts are expected to facilitate development of the overall economy as well as that of the local communities by creating wealth, generating employment, stimulating development of infrastructure, supplying raw materials to many of the industries, and thereby enhancing economic well-being. Mining has also the potential of contributing to the government exchequer considerably, and this additional revenue can be utilized for strengthening the capital base, increasing future production, and facilitating development at the local level. In addition,

[10] For example, drainage from the coal belts and industrial wastes in Angul-Talcher region of Odisha has raised the pollution level in the middle section of the river Brahmani, a perennial river having innumerable tributaries. At its upper reach, the river is polluted by effluents from Rourkela Steel Plant and the iron-ore mining industries of Bonai sub-division of Sundargarh district. Moreover, the NALCO Smelter (a PSU) has also contributed to the poor quality of the surface and sub-surface water in the district.

[11] Protests against land acquisition in India are not isolated cases. Many other developing countries in the world such as China, Malaysia, Peru, etc. have also struggled in meeting the land requirements for expansion of the mining and mining-based projects due to increasing social conflicts and mobilization against land acquisition.

[12] There are also studies that have focused on the issues like societal sustainability (Downing, 2002), food insecurity (Cernea, 2000; Robertson and Andersen, 2010; Downing, 2002), increasing social exclusion in general (Cernea, 2000) and exclusion of women in particular (Thukral, 1996), and loss of common property including civil and human rights (Kibreab, 2000) in explaining resistance against land acquisition.

given low agriculture potentiality in the state due to its geo-physical-climatic conditions, emphasis on secondary sector for development of the state economy is imperative. The paper is organized in five sections. While the second section of the paper examines the socio-economic outcomes of mining, the environmental consequences are assessed in the third section. The fourth sections attempts to compare the environmental consequences with international experiences. The fifth section summaries the major findings and concludes the paper with necessary policy suggestions.

Development Outcomes of Mining

The present paper assesses developmental impacts of mining in respect of economic status of people, and education and health infrastructure and outcomes in the mining districts vis-à-vis that in the non-mining districts of Odisha. This is done by estimating analysis of variance (ANOVA) models. The ANOVA models assess statistical significance of the relationships between a quantitative dependent variable and qualitative or dummy explanatory variable(s). In the present paper, the ANOVA models are estimated to compare the mean values of different measures of development for the mining districts of Odisha vis-à-vis that for the non-mining districts. For each measure *Y*, the following equation is estimated:

$$Y_i = \alpha + \beta D_i + u_i$$

Here, $D_i = 1$ for the mining districts and $D_i = 0$ for the non-mining districts. For any measure of development Y_j, if β is statistically significantly different from zero, this means that the mean value of Y_j for the mining districts is significantly different from that for the non-mining districts. The sign of estimated β indicates whether the mean value of Y_j for the mining districts is higher or lower vis-à-vis that for the non-mining districts.

Alternative measures of socio-economic development are used to substantiate the findings. While economic development is assessed in terms of size of the district economy, per capita income, share of the district in net state domestic product (NSDP), and wealth indices for the lowest 20 percent and the highest 20 percent of the population, social development is examined in respect of education and health infrastructure and outcomes. The indicators used for examining education infrastructure include student-teacher ratio, teacher-school ratio, and number of primary, middle level and secondary schools per 100 square kilometer, whereas that for health infrastructure comprise of number of health sub-centres, primary health centres, and community health centres. In order to assess educational outcomes, the present paper uses three measures, viz., literacy rate, gender disparity in literacy, and dropout rate. On the other hand, the health outcomes are assessed in terms of infant mortality rate.

Data on economic development indicators are collected from the official website of the reverse bank of India (RBI) (i.e., www.rbi.org.in); *States of India* of the Centre for Monitoring Indian Economy (CMIE), and *Economic Survey, 2012-13* of the Government of Odisha. Data on social development indicators and education and health outcomes are compiled from the *Annual Health Survey 2010-11 Fact Sheet of Odisha*, Office of the Registrar General and Census Commissioner, Ministry of Home Affairs, Government of India. Data on the environmental parameters are sourced from the Official Web Portal of the Ministry of Environment and Forests, Government of India, New Delhi (i.e., http://envfor.nic.in/division/india-state-level-basic-environmental-information-database-isbeid).

On the basis of the regression results of the estimated ANOVA models, Table 1 summarizes the differences in various measures of development between the mining and the non-mining districts[13]. As regards economic development, it is observed that the mining districts are better placed in terms of size of the economy, per-capita income and share in NSDP. However, there is no significant difference between the mining and non-mining districts when the wealth index is considered[14]. This means that mining has failed to benefit people in respect of their asset possession and availing basic facilities, such as structure of the house, source of drinking water; facilities for water treatment and safer drinking, access to toilet facility and electricity, source of lighting and fuel, possession of land, etc.

Table 1: State of Development in the Mining Districts vis-à-vis that in the Non-Mining Districts

Measure	Economic Development	Social Development			
		Education		Health	
		Infrastructure	Outcome	Infrastructure	Outcome
Significantly Higher	1. Size of Economy 2. Per-capita Income 3. Share in NSDP				
Significantly Lower					1. Rural IMR 2. Rural Female IMR

[13] The detailed regression results are presented in Appendix - I.

[14] Household wealth Index has been constructed at the state level using the assets possessed and the facilities availed by the households, such as structure of the house; ownership status of the house; improved source of drinking water; treatment of water by the households to make it safer for drinking, access to toilet facility, access to electricity, main source of lighting; main source of fuel used for cooking, land possessed, etc. The asset scores have been computed for each single household by using the following formula:

$$HH\_asset\_score = \left(\frac{(value\_asset\_variable) - (mean\_asset\_variable)}{Standard\_deviation\_asset\_variable} \right) \times weight\_component$$

No Significant Difference	1. Wealth Indices for Lowest 20 Percent 2. Wealth Indices for Highest 20 Percent	1. Student-Teacher Ratio 2. Teacher-School Ratio 3. No. of Primary Schools per 100 Sq. Km. 4. No. of Middle Schools per 100 Sq. Km. 5. No. of Secondary Schools per 100 Sq. Km.	1. Literacy Rate 2. Gender Disparity 3. School Children Dropouts	1. No. of Health Sub-Centres 1. Primary Health Centres 2. Community Health Centres	1. Urban IMR 2. Total IMR 3. Rural Male IMR

The same can be said in respect of social development. Except rural infant mortality (including that of rural female), the rest of the indicators relating to education and health infrastructure and outcomes do not show any significant difference in the mining districts vis-à-vis that in the non-mining districts. In other words, the state of social development in the mining districts is not significantly better off when compared with the non-mining districts. However, the health outcome in respect of rural infant mortality rate, especially of the females is better in the mining districts than the non-mining districts.

Thus, although size of the economy, contribution to NSDP, and per capita income in the mining districts of Odisha are better than the non-mining districts, there is no significant difference in most aspects of social development. The rural infant mortality rate is lower in the mining districts, but rests of the indicators of social development do not show any significant difference between the mining and the non-mining districts. In other words, like experiences at the international level, the relationships between mining and human wellbeing at the district level in Odisha is not very clear. This restricts us from linking the developmental outcomes to the severity of protests against land acquisition. Possibly, further analysis at micro level can provide better insights in this regard.

More importantly, while the mining projects have displaced people from their existing livelihood practices, lack of necessary capabilities coupled with information asymmetry and existing socio-political constraints have restricted many of them from being included in the mining-based development process. Further, mining and industrialization in many parts of the state have significantly influenced traditional occupations of the local people. This along with loss of agricultural land, forest cover and other natural resources due to acquisition is likely to have severe adverse impact on their livelihood. Rent-seeking behaviour and lack of transparency and accountability on the part of various agents seem to have deprived them further.

However, in order to understand people’s protests against land acquisition for mining and related projects, the socio-economic implications should be viewed in combination with its environmental costs that arise due to the negative externalities and irreversible damage done to the valuable ecosystem. In general, mining causes deforestation and imbalance in ecosystem, converts cultivable land into waste land, pollutes air, degrades water quality, and changes climatic conditions at the local level. Since the adverse consequences are high, necessary policies are formulated and legislative and administrative structures are designed to limit and/or internalize the negative environmental externalities of mining. In this perspective, what follows next is an attempt to understand the experiences on environmental consequences of mining and the corrective measures undertaken in this regard.

3. Review of Major Literature Studies

The cascading impact of mining on natural capital of an economy is a widely recognized conspicuous phenomenon. The imperative debate is, however, whether the loss of natural capital can be offset or it should be offset with a net gain in the other forms of sustainable capital, namely human, social, manufactured and financial capitals. The debate inherently reflects two interlinked facets: First, whether mining has the potential to turn capital investment into enhanced level of other non-natural capital stocks, thereby benefiting the state and the local community. Second, whether as a norm natural capital should not be used at a rate that exceeds the self-correcting and/or replacement capacity of the ecosystem or that reduces environmental quality, regardless of the developmental outcome. While opinions on the normative developmental path are divergent across researchers, outcomes of mining are too seen to be inconsistent across and within the mining economies of the world.

The issues raised by the normative approach of the debate are arduous to be answered in any rigorous manner due to lack of any comprehensive metrics. However, it is possible to catalogue the widespread environmental consequences of mining including its duration (whether long-term or otherwise) and nature (whether irreversible or otherwise) of impact. Such an analysis is essentially less because of the need to have a bird's eye view of the overall position of mining economies but more because to learn the intervention strategies adopted vis-à-vis the consequences to reduce the extent and intensity of impact. Perhaps then a grounded argument in favour of or against the prescriptive path of mining-led development can be arrived at. What follows next is an attempt to critically review the existing literature in this regard.

Mining is an important economic activity both in the developed[15] as well as the developing[16] economies of the world. The trade-off between mining and environment has pulled-off an active debate across both set of economies. The adverse environmental impact of mining, therefore, has a global manifestation and is multifaceted. Some of the major negative externalities of mining

[15] Some of the developed economies include the USA, Australia, Canada, Finland, Sweden, etc. During the early 1980's mining was an integral sector in many parts of the Europe like Silesia, Poland, UK, etc.
[16] In the developing economies such as India, China, Chile, Botswana, etc. mining industry is a dominant sector.

that besets these countries include threat to protected areas and loss of biodiversity (EAMR, 2013; ICMM, 2004; Maje et al, 2003), decline in water resources (Lahiri-Dutt, 2012; Reza and Singh, 2010) and forest cover (Wani and Kothari, 2008); ground water depletion (Besant, 2012; Rao, 2006); air and noise pollution (Ghose and Majee, 2001); water contamination (Mishra, 2009; CSE, 2008); change in land-use pattern and soil quality degradation (Singh et al, 2010); depletion of non-renewable resources, carbon emission and climate change (Greenpeace, 2008; CSE, 2008), etc. Besides, significant adverse impact on the livelihood (Kitula, 2006), community health (Shandro et al, 2011) and occupational health hazards (NIOSH, 2011; Donoghue, 2004) of the local communities, particularly of the indigenous population is also observed.

A recently released report by the World Bank shows that the cost of environmental degradation in India is around 5.7 percent of its GDP every year[17]. Performance of China is even worse on this account. A similar study conducted by the UNDP in 2008 puts up this figure at about 9 percent of the GDP in China every year. Interestingly, China, which is better placed than India in terms of HDI, does only marginally better in respect of Environment Performance Index (EPI), indicating that rapid economic growth has caused adverse impact on the environment in both these economies. Today, both India and China are home to the world's largest polluted cities (World Bank, 2013). India, in particular, has exceptionally bad air pollution largely because of combustion of coal and fugitive emissions[18]. The other major environmental problems in India include degradation of crop lands, pastures, forests and poor water supply and sanitation.

Table 2 shows that some of the mining economies such as Canada, Australia, USA, etc. have an equally strong/modest EPI and HDI. On the contrary, emerging economies such India, China, South Africa, etc. languish at the bottom end of EPI with a modest HDI. On the other hand, Papua New Guinea, which has experienced the impact of mining on a sizeable indigenous population, is the worst performing mining economy both in terms of EPI and HDI. However, the position of Australia and Canada in particular indicates that it is possible for the mining-dependent developing economies to perform well both on EPI and HDI. The countries with high EPI are seen to be the developed economies of the world. Hence, the developing economies need to combat the environmental problems through efficient regulatory mechanisms or intervention strategies in order to be placed high in terms of HDI. However, the question is what should be the intervention strategy to reduce the impact of environmental hazards of mining? What follows next is an attempt to understand how and in what manner specific international standards and norms have been incorporated into the domestic jurisdictions of some of the major mining economies of the world.

Table 2: Environmental Performance Index vis-à-vis Human Development Index of major mining economies of the world

[17] For details see World Bank, (2013).

[18] A survey by WHO on G-20 economies has found that 13 of the world's 20 most polluted cities is in India.

		Environmental Performance Index (2012)		
		Strong	Modest	Weak
Human Development Index (2012)	Strong	Sweden, Finland, Canada	Australia, USA, Chile	
	Modest		Botswana, Indonesia	South Africa, India, China, Mongolia, Russia, Ghana
	Weak			Papua New Guinea
Source: The standings on EPI (worked out by the University of Yale) is taken from http://epi.yale.edu/epi2012/rankings while that of HDI is taken from the Website of World Bank				

In Australia, ownership of mineral resources generally lies with the crown (in practice, it is with the state, the territory and the commonwealth governments), regardless of who owns the land. The commonwealth government is not the principal holder of mineral rights. Since mining is not explicitly mentioned in the Australian Constitution, ownership of minerals found onshore and offshore within three nautical mile of territorial limit belong to the relevant state or the territory government. Minerals found beyond the three nautical mile limit or in external territories are the property of the commonwealth government. Under the crown ownership, exploitation of mineral resources usually involves payment of a royalty to the relevant government. The Australian Constitution, being drafted in the late 1890s, does not include any reference to protection of the environment. Nevertheless, throughout the last century, the honourable High Court has progressively interpreted the Constitution in such a manner that the commonwealth government has been able to assume a range of legislative power with respect to the environment. The commonwealth government used such powers to pass the environmental protection legislation, the *Environment Protection and Biodiversity Conservation Act 1999* to cement its role. Contrary to this, in Papua New Guinea, there are environmental protection commitments within the constitution itself, whereas Tanzania's constitution ignores environmental matters and focuses on social conditions.

Thus, Australia has been directly influenced by the international commitments, agreements and conventions to which it has been a party. On the other hand, the economic pressures to create an environment with a sound regulatory base and in keeping the international environmental standards have played a greater part in driving environmental legislation in Tanzania and Papua New Guinea, rather than the international policy documents per se. More significantly, the World Bank has played a crucial role in case of both Tanzania and Papua New Guinea. For example, it has provided necessary funds for drafting the legislation and the institutions, and building frameworks to administer this legislation in Papua New Guinea. The legislation and environmental protection commitments included in Tanzanian and Papua New Guinea largely mirror the same in Australian legislation.

From the above discussion it is clear that exploitation of mineral resources is imperative in the development process of an economy, but it has also emerged as one of the main causes of pollution in many of the mineral rich economies. The environmental deterioration caused by mining occurs largely due to inappropriate and wasteful working practices and rehabilitation measures. The major environmental consequences of mining include land degradation, damage to water quality, pollution, and harm to livestock and wildlife biodiversity. Accordingly, there is a growing realization that mining activities should be undertaken in a fashion whereby economic benefits are maximized, social conditions are improved, and damages to the environment are minimized. Many of the countries across the globe have designed appropriate policies and regulations in this direction. In India, although many of the negative externalities of mining are addressed in the existing policies and regulations, their generalized approach has failed in capturing the local level issues adequately. Given the regional diversities in geo-physical conditions and socio-economic, demographical and political structure in the country, what is required is to understand the environmental consequences of mining and other human interventions at the local level and address the problems accordingly through appropriate policies and regulations. In this perspective, the next section of the paper attempts to examine the negative externalities of mining in Odisha.

4. Environmental Externalities of Mining in Odisha

The present paper assesses environmental externalities of mining in terms of changes in forest cover, ground water level, water quality, changes in climatic conditions, and health hazards. It is observed that while diversion of forest land for mining continues, the share has declined in all the mining districts of Odisha during 2005-10 (Table 3). This is possibly due to absolute increase in forest cover, though marginally, in most of the mining districts of the state. Further, the share of the districts in forest land diverted for mining is not uniform. Majority of the forest land diverted for mining was contributed by two districts, namely Kendujhar and Sundargarh. These two districts together accounted for 60 percent of the total forest land diverted for mining during this period.

Table 3: Changes in Forest Cover in the Mining Districts of Odisha

District	Proportion of Forest Land Diverted for Mining (%)			Share in Total Forest Land Diverted for Mining (2005-10) (%)
	2005	2007	2010	
Angul	3.38	3.69	0.81	9.44
Jajpur	21.44	16.13	11.54	5.01
Jharsuguda	27.59	25.99	10.74	7.86
Kendujhar	25.39	5.19	6.05	40.44
Koraput	4.03	3.77	2.26	6.14
Sundargarh	6.16	5.28	2.77	18.98

Source: Official Web Portal of the Ministry of Environment and Forest, Government of India, New Delhi. Retrieved from http://envfor.nic.in/division/india-state-level-basic-environmental-information-database-isbeid

Contrary to the change in forest cover, all the mining districts of the state have experienced decline in ground water level during 2004-2009, and the decline is substantial in Jajpur (Table 4). In addition, these districts have also recorded increase in pH level in water during this period. This means that mining has affected both quantity and quality of water adversely posing a serious threat on sustainability of the development process. In addition, exposed excavations and abandoned mines are likely to pollute the surface waters and raise harmful air-borne dust. In many cases, uncontrolled runoff from the surface and waste dumps, rolling down of materials especially from steep slopes and loss of vegetation can also increase sediments deposition in surface water bodies.

Table 4: Changes in Water Level and Water Pollution in Mining and Non-Mining Districts

District	Ground Water Level		Change	pH Level		Change
	2004	2009		2002-04*	2009-11*	
Angul	16.00	13.81	-2.19	7.59	7.85	0.26
Jajpur	35.83	28.99	-6.84	7.6	7.75	0.15
Jharsuguda	22.45	19.58	-2.87	7.63	7.85	0.22
Kendujhar	13.29	12.13	-1.16	7.43	7.75	0.32
Koraput	6.65	5.70	-0.95	NA	NA	NA
Sundargarh	15.37	13.50	-1.87	7.55	7.71	0.16
Mining Districts	18.27	15.62	-2.65	7.56	7.78	0.22
Non-Mining Districts	16.78	14.24	-2.54	7.71	7.83	0.12
All Odisha	17.13	14.55	-2.58	7.66	7.81	0.15

Note: *Average for the period
Source: Official Web Portal of the Ministry of Environment and Forest, Government of India, New Delhi. Retrieved from http://envfor.nic.in/division/india-state-level-basic-environmental-information-database-isbeid

Table 5 shows the level and variations in climatic conditions in respect of rainfall and temperature. While the level of rainfall and temperature is indicated in terms of their maximum, minimum and average measures, coefficient of variations is computed to examine the fluctuations in climatic conditions. In order to examine if the climatic conditions in the mining districts are significantly different from that in the non-mining districts, the ANOVA models are estimated and the regression results are shown in Table 6. It is observed that the levels and fluctuations in rainfall and temperature in the mining districts are not significantly different from that of the non-mining districts. In other words, mining has not caused any significant increase in temperature or variations in rainfall in Odisha. It is possible that mining has considerable adverse impact on climatic conditions in the vicinity of the mines in Odisha. But, since district is the unit of analysis, the present study fails to capture the same.

Table 5: Rainfall and Temperature in Mining Districts vis-à-vis Non-Mining Districts									
Districts		Rainfall (April/May to Sep/Oct) in mm				Temperature (April/May to Sep/Oct) in degree Celsius			
		Average (2000-2009)				Average (2000-2009)			
		Max	Min	Avg	CV	Max	Min	Avg	CV
Mining Districts	Angul	489.55	17.27	188.87	0.92	33.28	25.57	29.52	0.10
	Jajpur	465.40	23.31	208.91	0.79	32.12	27.15	29.70	0.06
	Jharsuguda	440.51	4.85	176.56	0.96	33.93	25.97	30.25	0.09
	Kendujhar	397.61	27.77	190.47	0.72	30.95	24.15	28.00	0.08
	Koraput	439.05	18.37	196.07	0.82	29.66	23.29	26.46	0.09
	Sundargarh	434.58	5.67	178.34	0.94	33.45	22.95	29.41	0.13
Average	MDs	444.45	16.21	189.87	0.86	32.23	24.85	28.89	0.09
	NMDs	487.08	16.45	198.56	0.89	32.30	25.95	29.15	0.08
	All Odisha	477.45	16.39	196.60	0.88	32.29	25.70	29.09	0.08

Source: Official Web Portal of the Ministry of Environment and Forest, Government of India, New Delhi. Retrieved from http://envfor.nic.in/division/india-state-level-basic-environmental-information-database-isbeid

Table 6: Results of ANOVA for Variables Relating to Climate Change				
Measure	Intercept	Dummy	F	R^2
Rainfall				
Maximum	487.08*	-42.63	1.64	0.06
Minimum	16.45*	-0.24	Neg.	Neg.
Average	198.56*	-8.69	0.70	0.02
Coefficient of Variations	0.89	-0.03	0.25	0.01
Temperature				
Maximum	32.3*	-0.07	0.02	Neg.
Minimum	25.95*	-1.11	2.63	0.09
Average	29.15*	-0.26	2.63	0.09
Coefficient of Variations	0.08*	0.02	1.38	0.05

Although the level and variations in rainfall and temperature in the mining districts do not differ significantly from that in the non-mining districts, air pollution, decline in ground water level, and increase in pH content in water seems to have affected the health of people adversely. The average number of persons dying due to water and air borne diseases is higher in the mining districts are higher as compared to that in the non-mining districts (Table 7). The number of death caused by water-borne diseases is very critical in Angul districts that houses majority of the coal mines in the state. On the other hand, the incidence of death due to air-borne is considerably high in Kendujhar, Koraput and Sundargarh[19].

Table 7:				
District		Water-Borne		Air-Borne
		Communicable	Non-Communicable	
Mining Districts	Angul	26	41	24
	Jajpur	9	1	4
	Jharsuguda	1	2	3
	Kendujhar			79
	Koraput			67
	Sundargarh			48
Average for the Mining Districts		12	15	38
Average for the Non-Mining Districts		11	10	27
All Odisha Average*		11	12	29

Source: Official Web Portal of the Ministry of Environment and Forest, Government of India, New Delhi. Retrieved from http://envfor.nic.in/division/india-state-level-basic-environmental-information-database-isbeid

While the incidence of acute respiratory infection is significantly higher, particularly in the rural areas of the non-mining districts, in respect of number people suffering from tuberculosis, there is no significant difference (Table 8). However, such observation may be caused by underreporting of cases or lack of awareness in the mining districts and any definite conclusion in this regard requires further scrutiny. This is very important as a field study at Angul district, a major coal mining district of Odisha, shows that the incidence of acute respiratory infection in the local population is very high. But, people are so much accustomed with these respiratory related diseases that they hardly ever report this problem to the health centres. Nevertheless, there are wide variations in acute respiratory infection between the mining and the non-mining districts of Odisha.

Table 8: Incidence of Respiratory and pulmonary diseases				
Diseases	Category	Mining Districts	Non-mining Districts	All-Odisha
Acute Respiratory Infection (ARI) per 1,00,000 population	Rural	284	1223	1027
	Urban	295	815	638
	Total	286	1136	964
Acute Tuberculosis per 1,00,000	Rural	145	143	148

[19] While, Kendujhar and Koraput are hotbeds for Iron-ore and Bauxite mining in the state, Sundargarh holds significance in terms of Coal and iron-ore mining.

population	Urban	113	88	92
	Total	135	136	139

Source: Annual Health Survey 2010-11Fact Sheet Odisha, Office of the Registrar General and Census Commissioner, Ministry of Home Affairs, Government of India

5. Summary and Conclusions

In the context of emergence of Odisha as a major investment destination, especially for mining, and subsequent protests against land acquisition for implementation of investment proposals, the present paper makes an attempt to examine if there are adverse environmental consequences of mining have forced people to resist acquisition. On the developmental front, the present paper finds that except some selected indicators like size of the district economy, per capita income and contribution of the district to NSDP, and infant mortality rate, mining has failed to provide any significant boost to the economy and the society of the respective districts. Possibly, lack of significant difference on economic and social front in the mining districts as compared to that in the non-mining districts has raised uncertainty in the minds of the prospective land losers and thereby has made the problem of land acquisition for mining aggravated. A development process with greater inclusion can make the land acquisition process smoother.

Given the lack of capabilities of many of the prospective land losers, information asymmetry, and institutional constrains, a path of forward vertical integration seems to have the potential of making the transition more inclusive. An economic integration between the mineral resources and other sectors has not only accelerated development of many of the national economies (Leaming, 2007; Cristobal and Biezma, 2006), it has also resulted in greater well-being of the local people (Ejdemo and Soderholm, 2011; Pasco´– Font et al., 2001; Castillo et al., 2001). Since a large number of investors are interested to set up the industries in steel and power sectors around the vicinity of the mining areas, strong vertical linkages across related sectors of the economy can be developed in the district. This may eventually enhance the level of income, employment and human development with considerable multiplier effects at the local level. This may also reduce the extent of exclusion and hence facilitate smooth acquisition of land for development projects.

However, along with facilitating vertical integration, adequate emphasis should be given on internalizing/liming the negative externalities of mining as it has caused significant adverse impact on quantity and quality of water resources posing threat on sustainability of the development process and raising incidences of death due to water-borne diseases. The incidences of death caused by air-borne diseases are also quite high in the mining districts of the state. However, the present paper does not find any significant change in forest cover or climatic conditions in the mining districts vis-à-vis that in the non-mining districts. Given that district is unit of analysis in the present paper, a further micro-level analysis is required to have better insights in this regard.

The findings of the present paper, therefore, suggest that the proposed 'Land Acquisition and Rehabilitation and Resettlement Bill' should have enough provision to address these negative environmental externalities of mining. Some possible solutions like revision of mineral pricing factoring the negative externalities, enforcement of tradable emission permits given by the state governments, etc. should be critically examined. In addition, appropriate laws should be enacted with necessary regulatory framework to guide the investors in performing their environmental responsibilities. A deeper understanding of local community' perception on how mining affects the environment is very important in this regard.

Appendix – I:

Table 1	Summary Statistics				
Indicators of Economic Development	Obsn.	Mean	SD	Min	Max
Size of the Economy†	30	11.83	0.67	10.45	12.86
Per Capita Income†	30	9.48	0.30	9.07	10.32
Proportionate share in NSDP†	30	0.03	0.02	0.01	0.08
Rural Wealth Index (lowest 20%) ††	30	25.97	12.27	11.10	48.20
Urban Wealth Index (lowest 20%) ††	30	5.96	3.97	1.10	17.40
Total Wealth Index (lowest 20%) ††	30	23.20	11.49	9.70	44.80
Rural Wealth Index (highest 20%) ††	30	11.22	4.65	3.60	19.70
Urban Wealth Index (highest 20%) ††	30	50.97	11.59	31.50	75.60
Total Wealth Index (highest 20%) ††	30	17.41	8.05	6.20	40.90
N.B. † refers to the average of the period 1999-00 to 2008-09 †† refers to the year 2010					
Source:					

Table 1A	Results			
Indicators of Economic Development	Intercept	Dummy	F	R^2
Size of the Economy†	11.71*	0.64**	4.89**	0.15
Per Capita Income†	9.33*	0.47*	18.05*	0.39
Proportionate share in NSDP†	0.03*	0.02**	0.86**	0.11
Rural Wealth Index (lowest 20%) ††	23.57*	-1.83	0.15	Neg.
Urban Wealth Index (lowest 20%) ††	26.08*	-0.53	0.01	Neg.
Total Wealth Index (lowest 20%) ††	5.42*	2.70	1.15	0.08
Rural Wealth Index (highest 20%) ††	16.60*	4.01	2.26	0.04
Urban Wealth Index (highest 20%) ††	10.95*	1.39	0.73	0.15
Total Wealth Index (highest 20%) ††	50.80*	0.89	0.05	Neg.
*N.B.: *, ** & *** refers to 1%, 5% & 10% levels of significance respectively*				
† refers to the average of the period 1999-2000 to 2008-09 †† refers to the year 2010				
Source:				

Table 2	Summary Statistics				
Education and Health Infrastructure	Obsn.	Mean	SD	Min	Max
Education Infrastructure					
Student-Teacher Ratio in Primary School †	30	40.97	7.13	30.00	56.00
Teacher-School Ratio in Primary School †	30	2.15	0.26	1.57	2.67

No. of Primary Schools per 100 Square KM †	30	36.57	16.46	19.00	75.00
Student-Teacher Ratio in Middle School †	30	34.30	7.49	22.00	47.00
Teacher-School Ratio in Middle School †	30	2.05	0.28	1.48	2.81
No. of Middle Schools per 100 Square KM	30	17.70	13.10	3.00	45.00
Student-Teacher Ratio in Secondary School †	30	21.53	4.08	12.00	32.00
Teacher-School Ratio in Secondary School †	30	9.38	2.90	5.48	18.71
No. of Secondary Schools per 100 Square KM †	30	7.47	5.91	1.00	23.00
Health Infrastructure					
No of Health Sub-Centres per One Mn Population ††	30	165.63	45.96	90.00	258.00
No of Primary Health Centres One Mn Population ††	30	30.27	6.09	20.00	49.00
No of Community Health Centres One Mn Population ††	30	9.70	2.84	5.00	19.00
† refers to the year 2010 †† refers to the year 2011					
Source:					

Table 2A	Results			
Education and Health Infrastructure	Intercept	Dummy	F	R^2
Student-Teacher Ratio in Primary School †	34.63*	1.21	0.38	0.01
Teacher-School Ratio in Primary School †	2.49*	0.01	Neg.	0.00
No. of Primary Schools per 100 Square KM †	37.38*	-4.04	0.33	0.01
Student-Teacher Ratio in Middle School †	44.38*	1.49	0.12	Neg.
Teacher-School Ratio in Middle School †	2.18*	-0.47	2.57	0.15
No. of Middle Schools per 100 Square KM	16.67*	-2.17	0.34	0.01
Student-Teacher Ratio in Secondary School †	24.00*	-2.00	0.83	0.02
Teacher-School Ratio in Secondary School †	7.88*	0.63	0.64	0.03
No. of Secondary Schools per 100 Square KM †	6.33*	-0.33	0.03	Neg.
No. of Health Sub-Centres per One Mn Population ††	165.71*	-0.38	Neg.	Neg.
No. of Primary Health Centres One Mn Population ††	30.46*	-0.96	0.19	Neg.
No. of Community Health Centres One Mn Population ††	9.79*	-0.46	0.24	Neg.
*N.B.: *, ** & *** refers to 1%, 5% & 10% levels of significance respectively*				
† refers to the year 2010 †† refers to the year 2011				
Source:				

Table 3	Summary Statistics				
Education and Health Outcomes	Obsn.	Mean	SD	Min	Max
Education Outcomes					
Male Literacy Rate ††	30	80.73	10.25	59.45	93.20
Female Literacy Rate ††	30	62.10	14.00	37.22	82.06

Total Literacy Rate ††	30	71.44	12.19	48.20	87.51
Gender Disparity based on Literacy Rate ††	30	0.33	0.15	0.13	0.60
Rural School Children Dropout Rate (Age 6-17 years) †	30	15.22	4.56	8.90	26.60
Urban School Children Dropout Rate (Age 6-17 years) †	24	10.38	4.11	3.70	19.40
Total School Children Dropout Rate (Age 6-17 years) †	30	14.49	4.28	8.30	25.70
Rural male School Children Dropout Rate (Age 6-17 years) †	30	14.23	4.65	8.1	26.5
Rural female School Children Dropout Rate (Age 6-17 years) †	30	16.23	4.64	9.7	26.8
Health Outcomes					
Rural Infant Mortality Rate †	30	65.10	12.39	50.00	103.00
Urban Infant Mortality Rate †	16	42.06	11.54	25.00	69.00
Total Infant Mortality Rate †	30	62.10	11.69	49.00	100.00
Rural male Infant Mortality Rate †	30	61.43	11.90388	48	101
Rural female Infant Mortality Rate †	30	68.97	14.34184	49	106
† refers to the year 2010 †† refers to the year 2011					
Source:					

Table 3A	Results			
Education and Health Outcomes	Intercept	Dummy	F	R^2
Education Outcomes				
Male Literacy Rate ††	80.77*	-0.22	Neg.	Neg.
Female Literacy Rate ††	61.90*	1.00	0.03	Neg.
Total Literacy Rate ††	71.35*	0.44	0.01	Neg.
Gender Disparity based on Literacy Rate ††	0.34*	-0.04	0.30	0.01
Total Gender Disparity based on Effective Literacy Rate †	0.13*	0.03	1.97	0.09
Rural School Children Dropout Rate (Age 6-17 years) †	14.43*	0.31	0.04	Neg.
Urban School Children Dropout Rate (Age 6-17 years) †	15.04*	0.88	0.27	0.01
Total School Children Dropout Rate (Age 6-17 years) †	10.05*	1.59	1.19	0.03
Rural male School Children Dropout Rate (Age 6-17 years) †	13.95*	1.42	0.12	0.01
Rural female School Children Dropout Rate (Age 6-17 years) †	16.17*	0.33	0.02	Neg.
				Health Outcomes
Rural Infant Mortality Rate †	67.17*	-10.33*	10.03*	0.12
Urban Infant Mortality Rate †	43.50*	-3.83	0.45	0.03
Total Infant Mortality Rate †	64.17*	-10.33*	13.83*	0.19

Rural male Infant Mortality Rate †	62.54*	-5.54	1.04	0.04
Rural female Infant Mortality Rate †	71.92*	-14.75**	5.94**	0.18

*N.B.: *, ** & *** refers to 1%, 5% & 10% levels of significance respectively*

† refers to the year 2010
†† refers to the year 2011

Source:

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