Sustainable exploration of oil and natural gas on economic and ecological basis
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ABSTRACT

The paper elucidates the adverse ecological impacts of oil exploration. Four case studies are briefly discussed, throwing light upon issues that are considered tangential to the oil sustainability debate. Oil wells have historically been vulnerable to both wartime and asymmetrical threats, thus posing a grave risk to both human safety and the environment. Oil spills mostly attributed to human error, have an equally deleterious impact on the flora and fauna, such as in the Mumbai oil spill. Indian market policies are known to be greatly influenced by communism with freebies on behalf of the exchequer being a classic example. The Indian economy besmirched by such consumer-end freebies has led to a debt ridden oil sector, discouraging further research in eco-friendly oil production. Lastly the contentious issue of why India should take a cautious approach in shale gas exploration with its dubious environmental credentials is analyzed. Drawing from the case studies, certain recommendations are presented that need to be incorporated in the existing policy framework to ensure that India is poised for an effective environmental governance program, testing India's democratic principles for their legitimacy and practicalities.

Keywords: Oil, shale gas, environment, economy, government, industry

1. Introduction

“If development is the vehicle and we humans the driver then energy is undoubtedly the fuel, both figuratively and literally.” With the advancement in technology, energy has evolved over the ages from muscular and biomass to coal during the industrial revolution and finally to oil and natural gas. While the advent of the 21st century brought nuclear fusion, ‘the cleanest available source’ into the global energy milieu and refocused the debate on renewable sources, the fact remains that fossil fuels are indispensable at least for the near future since nuclear fusion is still in its early stages of inception and renewable sources are not commercially viable due to technological constraints along with the comparatively lower colorific values.

Energy security is counted as a key parameter for the development of a nation, making the oil and gas industry along with the coal sector a diverse and vital part of the economy. While coal is the largest energy source at present, coal’s future looks bleak as compared to that of oil since it is by far the dirtiest energy source; oil sector, on the other hand is becoming more diverse with natural gas and shale gas coming under its ambit. Nevertheless, wanton misuse of technology, mired by weak polices has led to a drastic increase in the ecological impacts of oil exploration. Although in recent years, governments and corporations of various countries have taken cognizance of the alarming deterioration of Earth’s ecology; their pro ecological crusade has often been speculated to be an ostensible exercise for safeguarding vested
interests. The long term solution to ameliorating a world heavily dependent on non-renewable energy lies in sustainability, i.e., energy exploration both commercially and environmentally viable, for which the onus lies on both the government and the oil sector.

Figure 1: Evolution of energy (Jean-Paul Rodrigue, 2013)

2. Oil- an easy war target

A declassified CIA analysis regarding the destruction of Kuwaiti oil fields during the Gulf War stated that: *Indeed, Iraq went to great lengths to ensure that the sabotage was successful. According to [deletion] Baghdad issued detailed instructions to oilfield engineers dispatched to Kuwait during the occupation on how to place explosives on the wellhead and how to hook up the detonation cord so that a group of wells would simultaneously explode. The [deletion] indicate that the Iraqis experimented months beforehand by blowing up well mockups in Iraq (CIA, 1991).

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During the Persian Gulf War (1990-1991) Iraq embarked on a systematic decimation of Kuwait's oil industry by setting fire to 789 individual oil wells which had catastrophic...
impacts on the Kuwait oil industry and the region’s ecology (Robert Housman and Dee Martin, 2001). The ecological landscape of the Persian Gulf was irrevocably damaged and it may be decades before the environment is restored to its pre-war balance. Burning of oil wells generated a large amount of soot which made hundreds of miles of the Kuwaiti desert uninhabitable since one gram of soot blocks out two-thirds of the light falling over an area of eight to ten square meters. To make matters worse weather patterns and climactic conditions carried the soot to the neighboring remote areas to seriously hamper the agriculture sector. It was estimated that 250 million gallons of oil - more than 20 times the amount spilled in the Exxon Valdez disaster in Alaska - flowed into the Gulf along 440 miles of Saudi Arabia's coastline (Dr. Culture). Documents show that many endangered species native to the Gulf region, such as the green and hawksbill turtles, leatherback and loggerhead turtles, dugongs, whales, dolphins, and sea snakes died as a result of exposure to oil or from polluted air; thousands of migratory birds including cormorants and flamingoes met with the same fate. The fishing industry, one of the biggest contributors to Kuwait’s economy was drastically affected by the oil spillage into the Gulf: approximately 120,000 tons of fish used to be harvested a year prior to the invasion but after the oil spillage, the numbers significantly dropped. In addition to the commercial fishery sector, many lives on the coast were devastated since fishing is a subsistence activity and the oil spillage disrupted the spawning of shrimp and fish (American University, TED Case Studies).

3. Mumbai oil spill

The 2010 Mumbai oil spill occurred after two Panamian-flagged ships, MSC Chitra and the MV Khalijia-III collided off the Indian coast at around 9:50 a.m. local time on 7th August, 2010. MSC Chitra had a cargo of 1,219 containers holding 2662 tonnes of fuel, 283 tonnes of diesel and 88040 litres of lubricant oil along with 31 containers having pesticide. The collision was so severe that MSC Chitra tilted sharply, throwing the oil containers into the Arabian Sea (National Environmental Engineering Research Institute). Although the Navy and the Coast Guards immediately came into action to neutralize the oil spill with the help of equipment imported from Rotterdam and Singapore, it took forty-five days for all the oil to be pumped out and another six to eight months for the ship to be removed from the spot.

The oil spill had chilling impacts on Mumbai’s ecology. An eyewitness account best explains the shocking situation: “A snake which came in from the sea was covered in oil and chemicals and was struggling. Neither could it go back into the sea as it is filled with oil, nor could it remain in the open in the baking sun. The oil spill has turned deadly. And it’s not just this one snake” (NDTV, 2010). The oil slick along with contaminating the marine life entered the sensitive mangrove belt. It was feared by environmentalists that the oil slick which entered the mangroves and mudflats couldn’t be retrieved and even if it could India didn’t have the technology or the intent to do so. Eventually mangroves did turn black while the toxic chemical bottles got washed ashore. Fishermen claimed that their fishing nets were all covered with oil and that the fishes caught were inedible. It was estimated that four billion dollar of trade would have been lost if the oil spill wasn’t dealt with immediately (Safar Mohammad Khan, 2010). The sole silver lining in the entire fiasco was that the oil supply wasn’t disrupted since Oil and Natural Gas Corporation (India’s largest oil and gas exploration company) relied on its pipelines to compensate for the blocked ports. Other oil corporations, namely Indian Oil Corporation Limited (IOC), Bharat Petroleum Corporation Limited (BPCL) and Hindustan Petroleum Corporation Limited (HPCL) used their inventories to survive the crisis.
4. Oil and Gas Pricing - a populist rhetoric or a liberalized approach?

The steps taken towards natural gas pricing in USA and India are in sharp contrast to each other; while United States enjoys a highly competitive deregulated natural gas market with an efficient pipeline transportation infrastructure (Andrej Juris, 1998), India being communist-friendly markets heavily subsidized oil and gas. The result has been immensely positive for USA, where natural gas prices have fallen from $14/MCF in 2005 to approximately $4/Mcf in 2013, leading to wholesale electricity prices being cut by more than half and an increase in manufacturing (Himangshu Watts, 2013). Since oil companies were assured of their investment in the US energy sector, they improved their exploration technology and developed additional sources to mitigate the US energy crisis by a significant margin. Thus in USA, price deregulation has benefitted both the consumers who get offered a broader range of services at lowered prices, and the environment. On the other hand, the Indian oil sector is in shambles. The oil marketing companies were reported to be losing Rs.443 crore a day at Rs.9.22 per litre on diesel, Rs.31.6 per litre on kerosene and Rs.481 per cylinder (15.2 kg) on LPG as of Feb 1, 2013. The subsidy burden of Oil and Natural Gas Corporation, India’s biggest oil explorer, was estimated to cross Rs.50,000 crore in the fiscal year 2013 (Promit Mukherjee, 2013).

Upstream industries in India, provide oil at subsidized rate to refineries at $56 per barrel of oil with the oil pumping cost around $38 per barrel. Since the discount price is decided at a particular value of the volatile global oil price, companies are left with little money, approximately $4 a barrel for future operations. The situation is made worse when the Government includes the production of condensates (low density hydrocarbon liquids extracted as co-products) in the total output pushing the discount to $63/barrel (Sanjay Dutta, 2013). In mid-2013, the Government saw fiscal sense in breaking from the clutches of populist rhetoric: the Cabinet Committee on Economic Affairs (CCEA) approved the Rangarajan panel’s gas pricing formula and doubled the price of natural gas to $8.4 from 14th April 2014, under heavy attack from the Left parties which speculated crony capitalism (Deccan Herald, 2013). However barring such few notable exceptions, the oil sector is still not completely liberalized and many such steps are needed from the Government to increase the prices of consumer end products especially kerosene and diesel to enable greater research in industries on cleaner and efficient oil production techniques.

4.1 To shale or not to shale?

Shale gas is the latest entrant in the global energy block, made popular by USA which in its desperation to cut short the energy crisis pushed shale gas production from 0.3 trillion cubic feet in 2000 to 9.6 trillion cubic feet in 2012 (U.S. Energy Information Administration, 2013). Countries all across the globe, namely UK, China and Australia are emulating USA model in shale rapping because natural gas is viewed as a low priced alternative source compared to wind and nuclear power, and even to coal generation.

Shale gas, an unconventional fossil fuel, is the natural gas trapped deep underground in fine-grained sedimentary rocks (U.S. Energy Information Administration, 2012). Long horizontal wells are drilled through shale beds more than a kilometer below the surface and huge quantities of water, sand and chemicals are pumped into the rocks at high pressure in a process called fracking to facilitate the opening of the fissures in order to allow the trapped gas to escape (George King, 2012). In recent times various controversies surrounding the environmental impacts of shale gas have come into light. Figures from the US Government...
and industry estimate that at least a third more methane leaks from shale gas extraction than from conventional wells. Compared to coal, the carbon footprint of shale gas is at least 20% greater and perhaps even more than twice as great on a 20-year basis (Richard Black, 2011). Fracking involves pumping of poisonous chemicals along with several million gallons of fresh water, into each well: around 80 per cent of the mixture remains underground while the remaining 20 per cent rises to the surface, where it is not always disposed of safely, hence posing a threat to nearby aquifers. This connection has been acknowledged by the US Environmental Protection Agency in the case of one Wyoming community and by a whistleblower who claimed in 2012 that fracking could poison New York’s drinking water (Karen McVeigh, 2012). Additionally the 2010 documentary film, ‘Gasland’, showed people near an exploration site setting tap water on fire (Huffington Post, 2010). Deforestation and soil disposal are common practices for shale gas sites and explosions in fracking have been known to cause tremors. Cuadrilla’s UK operations were stopped after they generated tiny earthquakes in the region (Duncan Clark, 2012) while in France and Bulgaria fracking has been banned due to environmental concerns (BBC, 2012).

![Figure 2: Global Shale Gas Basins, Top Reserve Holders (U.S. Energy Information Administration, 2013)](image)

In order to decrease the fiscal deficit and strengthen the manufacturing sector India needs to increase its domestic energy production. Shale gas extraction seems a lucrative solution since 3,800 million barrels of shale oil and 96 trillion cubic feet of shale gas have been discovered in India which are two-third of India’s current oil reserves and more than double the natural gas reserves. But the question of shale gas needs to be addressed with care by taking various environmental concerns into account. Either way, India should ensure safe drinking water to 16% of the world’s population from just 4% of the total water resources.

4.2 Proposed recommendations

4.2.1 Security of oil assets

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Petro-terrorism, a 21st century form of terrorism created by the al Qaeda as a tactic against Western countries is fast spreading across the world, threatening to dismantle the global oil storage and transportation infrastructure (Peter Johnston, 2008). India is developing three storage facilities, located at Visakhapatnam, Mangalore, and Padur under the ambit of Strategic Petroleum Reserve (SPR) along with showing keen interest in the 1,700-mile Iran-Pakistan-India Pipeline and 1,050-mile Turkmenistan-Afghanistan-Pakistan-India Pipeline (U.S. Energy Information Administration, 2010). The three storage facilities are in danger from indigenous insurgents involved in guerrilla tactics while the pipelines are potential transnational terror targets. In order to protect its oil assets, India should consider taking the following steps:

1. A robust and extensive intelligence gathering and analysis system should be established in order to preempt vulnerabilities. A thorough audit of the extant oil infrastructure and assessment of its security status should be done at the earliest for vulnerability assessment. The intelligence gained should be shared with oil companies to engender appropriate emergency response plans. Also sensitive information regarding oil storage and wells should be restricted in the public domain.

2. In case of integrated international energy grids, the Government should coordinate with its counterparts at different levels to enact consequence management plans in light of a terrorist attack happening.

3. In case of pipelines, a proper control system should be installed for fault detection and isolation along with physical security measures such as monitored fences and controlled access points. The infrastructure should be made more resilient on the lines of Baku-Tbilisi-Ceyhan (BTC) pipeline that connects oilfields in the Caspian Basin with a Mediterranean Sea oil outport, which is buried for most of its 1,700km and runs through countries that are less likely to disrupt the oil flow (Svante Cornell and Fariz Ismailzade, 2005).

4.2.2 Oil spills: prevention and cure

1. Proper Contingency Response Plans for various sizes and types of oil spills should be put in place by the National Disaster Management Authority (NDMA) after having detailed discussions with appropriate government bodies and the local community. The contingency plans should be based on worst case scenarios and should be segregated into three tiers: local, state and national levels. The objectives of the plan should be to ensure the safety of the personnel in the event of an oil spill and minimize the ecological impacts of an oil spill while protecting the shareholders’ assets. Industry employees should be provided with adequate training on oil spill management and disaster response, to make them aware of their roles in preventing and responding to oil spills.

2. There should be management systems to identify, control and monitor risks, in compliance with the government regulations and industry guidelines. It should be made necessary for the oil industries to conduct regular audits in their oil operations including machineries and infrastructure and submit the report to NDMA. In addition to the internal inspection, surprise reviews and objective assessments of oil industries should be done by NDMA officials, bereft of any influence by the industry.

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3. Regional citizens’ advisory councils (RCACs) should be formed, following the model of the Prince William Sound RCAC, which was established by the Oil Pollution Act of 1990 after the Exxon Valdez oil spill (PWSRCAC, 2013). Citizen participation through such independent councils leads to an oversight of industry activities, prevents complacency and thus ensures vigilant review. The spill contingency plans should be regularly scrutinized for well-maintained response capability to disasters.

4. In case of negligence the guilty party should be tried by a fast track court under criminal offences and should be held responsible for the expenditures incurred in cleaning and reinstating the degenerated environment. In addition a heavy fine for damages to ecology and infrastructure should be imposed on the culpable party.

4.2.3 Less subsidized, more eco-friendly oil exploration

India should remove all subsidies or reduce them to extremely low levels depending on the market volatility, from crude oil and all its derivatives, infusing more liquidity into the cash strapped oil sector. Since subsidies have a tendency to be viewed as entitlements and any attempt to reduce them can be politically hazardous (Ronald Steenblik, 2007), the following two solutions are proposed:

1. Gradual Phase-out
   A gradual phase-out of subsidies can give recipients time to adjust. Instead of having significant price jumps, the Government should implement small increments on a regular basis over a clear timeframe after taking the macro-economic factors into consideration.

2. Monitoring and Adjustment
   Regular monitoring and adjusting reform is necessary to ensure that subsidies are not exploited, by making them target the vulnerable sections of the society. The onus for ensuring a healthy oil sector with competitive market prices through deregulation of all fuel variants, lies here.

It should be made mandatory for every company whether public or private to direct a significant portion of the freshly available liquidity in Research Design and Development to make oil extraction processes eco-friendly. To ensure transparency in operations, an annual report on the research progress should be reviewed on a regular basis at the Cabinet level. All R&D activities, through a dynamic Public-Private partnership, should be brought under a single umbrella program with clearly defined outcomes, in order to:

1. Facilitate the research, design & development of novel renewable energies and make existing renewable energy technologies more reliable and cost effective.
2. Provide risk and venture insurance to scientific entrepreneurs and fund Indian companies to acquire technology intensive foreign companies.
3. Enable research facility sharing between companies and bridge the gap between industries and research institutions through research scholarships and programs.
4. Promote renewable energy for industrial & commercial applications in urban areas and for agrarian use in rural areas. Encourage energy recovery from municipal waste in class-I cities and industrial wastes.
6. Exploit the renewable energy potential of various regions in India, such as wind energy in Gujarat and solar energy in Rajasthan.

4.2.4 Exploitation of shale gas

There is an obvious interest in shale gas exploration around the world, given the enormous success in the US. In India, six potential shale gas basins were identified by the Ministry of Petroleum and Natural Gas and a draft policy for shale gas exploration was placed in 2012 (Gardiner Henderson, 2013). Since a final policy on shale gas is yet to be announced and shale exploration has remained largely untested in India, two policy alternatives are provided.

4.3 Alternative 1: No to shale gas exploration

1. There is an intense scarcity of drinking water in India, which will only worsen in the coming years. The report investigating the potential impacts of fracking on drinking water and groundwater in USA, asked by the US Congress from The Environmental Protection Agency (EPA) has been further delayed for two years from 2014 to 2016 (Trisha Marczak, 2013). Thus there is an absence of credible analysis of the environmental impacts of shale gas exploration.
2. Due attention has not been given to other alternatives, namely coal bed methane (CBM) and gas hydrates. Although 33 blocks for CBM exploration have been awarded since 2001, mainly in east India, the production is currently around just 3 bcm per annum. Prior to exploring shale gas, the bottlenecks in CBM exploration concerning environmental clearances, land acquisition, and pricing should be resolved. In case of gas hydrates, a national R&D Centre for gas hydrates, as asked by DGH Hydrocarbons, has still not been established. Even after the formulation of National Gas Hydrate Programme in 1997 and the Indo-US initiative exploring four seabed areas in 2006, nothing concrete has happened. India has no definite future plans for production of gas hydrates unlike Japan which has announced that it will commence its hydrates production by 2016.
3. Exploration of conventional gas can be increased through business friendly domestic policies by tackling policy paralysis and subsidy regime. Companies can also be encouraged to acquire more gas equity abroad, imitating the success of BPCL and Videocon in Mozambique.

4.4 Alternative 2: Yes to shale gas exploration

In the light of the Indian Government, nevertheless, approving shale gas exploration in its soon to be released policy, the following suggestions should be taken into consideration:

1. Even in the absence of the EPA report on fracking due in 2016, a careful analysis of credible studies concerning the environmental and public health impacts of shale gas, must be done. The harmful effects of chemicals used in fracking should be studied by an expert committee and the findings tabulated in a national database. All chemical
compounds used in fracking should be disclosed in the public domain. The lessons learnt by other nations, notably USA should be used to shape appropriate regulations for domestic exploration.

2. The contract duration should be divided into periods; while the first period should be for exploration, appraisal, evaluation and feasibility of the prospect, the second period should be for the development and production. There should be adequate oilfield service sector capacity for both the phases.

3. Industries should be encouraged to invest in eco-friendly fracking techniques. The exploration of shale gas should entail the latest techniques of advanced well designs and equipment to reduce the fracs per well. Multiple layers of steel casing should be used to prevent water contamination and closed-loop drilling to minimize water usage and discharge of toxic waste. Waste water should be treated by brine before discharging it in nearby water bodies.

4. Industries should be encouraged to reduce their water consumptions and develop green belts to counter greenhouse effect. Exploitation of shale reserves in ecologically sensitive areas should not be allowed.

5. In accordance with India’s new land acquisition bill, there should be close monitoring of the impact of gas exploration on sources of drinking water. There should be proper documentation of the water levels in aquifers.

6. Since horizontal drilling is a land intensive activity, industries should reduce the geographical footprint by developing super-pads (multi-well pad systems enabling drilling of multiple wells from a single location) in areas with high population density.

5. Conclusion

For any country to prosper, unlimited supply of energy is an important prerequisite but to sustain the very existence of human civilization, ecology plays a crucial role. Thus a compromise between human development and nature has to be reached, thriving on the limited resources available. The Indian Government should protect its oil assets, viewed as instruments of strategic importance and not follow Kuwait’s trajectory in the Persian Gulf War. The Government should further ensure that robust strategies are drafted after due consultation with the concerned parties instead of vacillating on policies and squandering the taxpayers’ money on pointless subsidies with no tangible results. The oil sector, meanwhile, is obliged to follow its societal responsibilities both in letter and spirit by taking eco-friendly initiatives on its own accord. To ensure transparency and accountability there should be proper regulation not only from external sources but also rigorous oversight from internal parties within the oil sector. The deteriorating state of the present day world is a constant reminder that the ecological costs of the non-renewable sector cannot be ignored since they more than compensate the economic costs of renewable sources. The Indian economic growth should not be at the expense of a clean future; otherwise it will only be a pyrrhic victory.

6. References


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