Petroleum Exploration in Sri Lanka and its Anticipated Benefits

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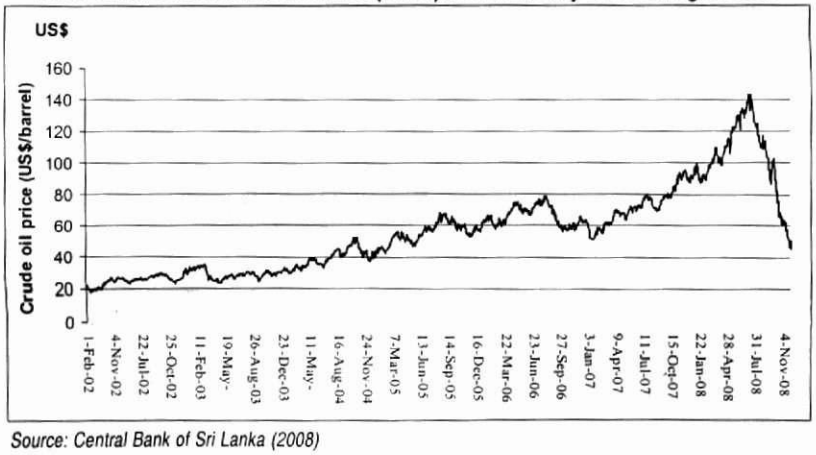
Abstract

A cheap energy source is a must for a country's economic prosperity. Sri Lanka has commenced exploring its petroleum prospects in the Mannar Basin. Seismic data reveals that the Mannar Basin is prospective in terms of petroleum. Newly-approved Petroleum Resources Act has formulated the necessary legal framework facilitating the private sector participation in the Sri Lankan petroleum industry. The Petroleum Resource Agreement signed between the Government of Sri Lanka and the International Oil Company regulates entire exploration operations in certain exploration blocks. If the company is able to discover petroleum deposits and develop an economically viable industry, the Sri Lankan Government will get royalty, profit petroleum, income taxes and the income of a National Oil Company. The industry will create a lot of job opportunities and a huge economic boom in the country. Lack of a Workstation, Data Storage Facility and consultants are some of the challenges faced by the industry. Non- affordability of seismic data creates poor response and low competition during licensing rounds. Cauvery Basin is more prospective and financially less risky compared to the Mannar Basin. Exploration has to be extended to other prospective areas, particularly to southern and eastern offshore areas. Chances of finding prospects within the country are slim.

Introduction

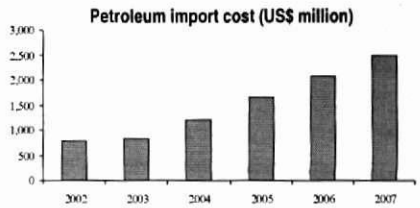
A cheap energy source is vital for a country's economic prosperity. From the early years of the last century, global economy became more and more dependent on petroleum products such as gasoline, diesel, kerosene, etc. Now petroleum has become such an indispensable energy source and it is difficult to imagine a world without it. Even though alternatives like hydrogen and ethanol have come to the arena, scientists are yet to discover a more cost effective and eco-friendly alternative to petroleum. Entire proven petroleum reserves in the world are approximately 1.2 trillion barrels and the world is consuming about 85.5 million barrels a day. If this rate remained unchanged, the global oil reserves would run out in around 40 years. But the annual demand for oil and gas is increasing day by day mainly due to a couple of immerging giant economies, India and China. These two countries alone accommodate almost half of the world's population. The International Energy Agency predicts that the world's daily consumption of petroleum would have risen to 106 million barrels by 2030 (Hoyos & Blas, 2008). It means that remaining oil reserves would last only about 30 years. Unless new reserves or a sound alternative to petroleum is discovered, the world will be racing towards a severe energy crisis by 2040. No alarm on a global energy crisis was foreseen until the turn of the 3rd millennium, when the crude oil price was as low as 20 US dollars a barrel. From 2002 to July of 2008, the price of crude oil has raised more than seven fold up to 147 US dollars a barrel (Figure 1). Not only developing counties like ours, but also super giant economies like the United States of America, Japan and Germany have been severely affected by the elevated oil price. Our condition is far worse due to the fact that Sri Lanka is not an oil-producing country and the entire national demand for petroleum is met by crude oil imports. From 2002 to 2007, Sri Lankan oil bill has raised three fold (Figure 2). In 2007, the Government of Sri Lanka spent about 2.5 billion US dollars on petroleum importation, which is about 8 % of that year's gross domestic product (GDP). This colossal amount of wealth being flown out of the country exert a sever pressure on Sri Lanka's balance of payments and the exchange rates. As a result, Sri Lanka has never been more hopeful than these days for exploring its own petroleum reserves.

Figure 1
Price variation of a crude oil barrel (Brent) from February 2002 to August 2008



Source: Central Bank of Sri Lanka (2008)

Figure 2
Oil bill of Sri Lanka from 2002 to 2007



Source: Central Bank of Sri Lanka (2007)

History of Petroleum Exploration in Sri Lanka

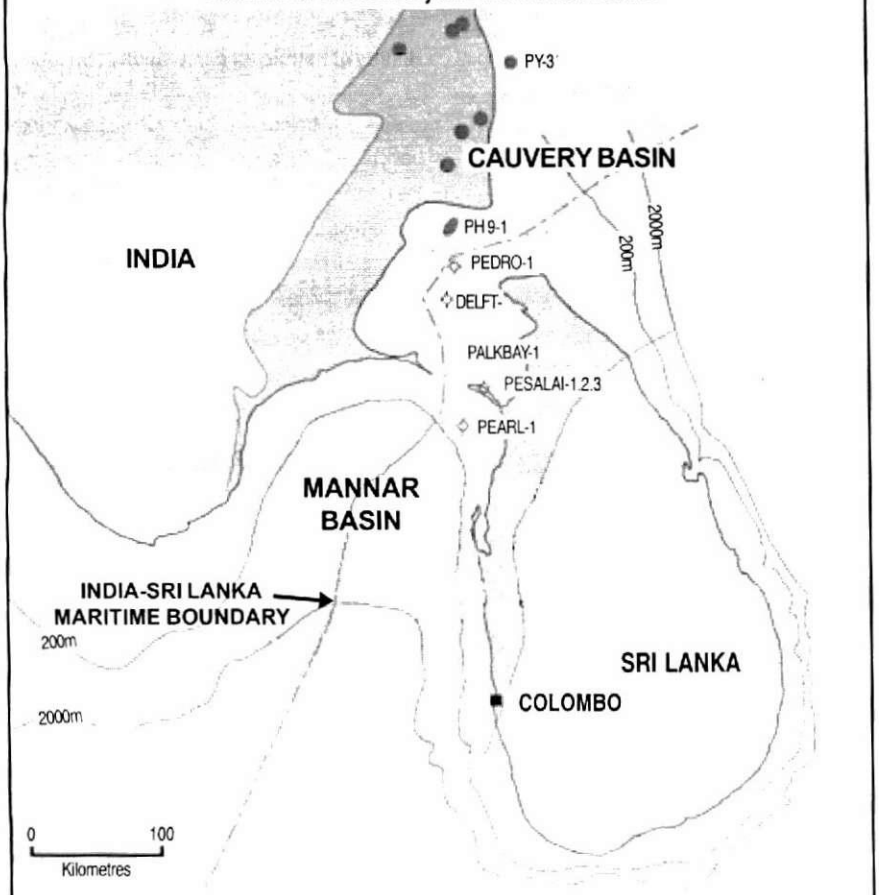
History of petroleum exploration in Sri Lanka goes back to 1957. This early exploration effort targeted the Cauvery Basin, which is located between north-western Sri Lanka and the eastern Indian coastline (Figure 3). Maritime boundary between India and Sri Lanka divides the basin into two halves. Indian sector of the Cauvery Basin is referred to as the Indian Cauvery Basin while the Sri Lankan Sector of the Cauvery basin is referred to as the Sri Lankan Cauvery Basin. Detailed geophysical surveys to locate petroleum deposits in the Sri Lankan Cauvery Basin were undertaken during 1967 - 1970 period by a French company and the Soviets. In 1974, the Soviets drilled Pesalai-1 exploration well in the Mannar Island located in the Sri Lankan Cauvery Basin. Encouraged by gas shows in the well, another two exploration wells, Pesalai-2 and Pesalai-3, were drilled in close proximity to the first well. But no commercially viable petroleum accumulations were found. Geochemical analysis preformed on core samples recovered from these wells confirmed existence of petroleum in trace amounts, which was very encouraging. Later four more exploration wells, namely Pearl-1,

Delft-1, Perdo-1 and PalkBay-1 (Figure 3) were drilled by several consortium companies without a success. Petroleum exploration, which was relinquished in 1984, remained dormant for more than nearly a quarter of a century until 2001.

Resumption of Petroleum Exploration

At the turn of the 3rd millennium, Sri Lanka resumed exploration by signing a contract with a Norwegian Geophysical Company, namely TGS-NOPEC for exploration of petroleum on cost recovery basis in offshore area under the Sri Lankan jurisdiction. TGS-NOPEC started exploration activities in the Sri Lankan Mannar Basin (Figure 3), which extends over 33,714 square kilometres. Like in the case of the Cauvery Basin, the Mannar Basin is also shared between India and Sri Lanka.

Figure 3
Location of the Cauvery and the Mannar Basins



Note: Solid circles on top centre are the oil reservoirs discovered in the Indian Cauvery Basin
Source: Modified after PRDS

The most powerful tool in detecting petroleum deposits in an area is the seismic technology. TGS-NOPEC acquired 1050-kilometre two-dimensional (2D) marine seismic data in 7 lines under the first phase of exploration. This seismic survey is more like a reconnaissance survey as adjacent lines are approximately 75 kilometres apart. Encouraged by the interpretation of the first seismic survey, TGS-NOPEC undertook another 4500-kilometre more detailed 2D seismic survey in 2005. The second survey had 49 lines with about 8-kilometre line spacing. However, any petroleum deposit located in between any adjacent seismic lines was not detected. Exploration geologists wondered as to why TGS-NOPEC prioritised the Manner Basin leaving behind more prospective Cauvery Basin. The agreement between the TGS-NOPEC and the Sri Lankan Government was supposed to last until 2012. However, it was abrogated by the Sri Lankan Government in 2006.

Petroleum Potential of the Cauvery and Mannar Basins

Mannar Basin is the southern extension of the Cauvery Basin, which is located in western offshore of the country (Figure 3). Based on the interpretation of seismic and gravity data, TGS-NOPEC disclosed that the Mannar Basin has petroleum deposits for an economically viable industry. Baillie and his co-workers have published these findings as a research paper at the 64th conference and exhibition of European Association of Geoscientists and Engineers (EAGE) held at Florence in Italy in May 2002. Seismic sections show that the Mannar Basin has necessary geological structures like anticlines and faults necessary for petroleum accumulation. The only exploration well in the Mannar Basin was Pearl-1 (Figure 3), which was drilled in 1984 in the northern most realm of the basin. It penetrated the rocks of the Mannar Basin up to 3,050 m depth. The stratigraphic section of the well reveals to have rocks capable of accumulating petroleum. Other than that, the Mannar Basin is devoid of evidence to accurately assess the petroleum potential. The water depth of the Mannar Basin ranges from 50m to 3,000 m (Baillie et al., 2002). Exploration operations in this sort of water depths are relatively costly. Hence, the exploration in the Mannar Basin is extremely risky in terms of investment. However, modern exploration techniques are capable of delivering goods in this sort of a risky domain if exploration is managed and coordinated prudently.

On the contrary, the Cauvery Basin is more prospective mainly due to the fact that India is producing oil and natural gas from their side of the basin. Solid circles on top centre of Figure 3 show the location of oil deposits. Therefore, the basin is promising for both oil and gas. Geology of the Sri Lankan Cauvery Basin is better known compared to the Mannar Basin due to the exploration wells drilled previously in the 1970s and the early 1980s. Water depth of the basin is around 10 metres. Therefore, exploration operations are easy and cheap compared to the Mannar Basin. Rocks in the Sri Lankan Cauvery Basin display excellent reservoir and source characteristics. In other words, it has rocks capable of producing as well as accumulating commercial qualities of petroleum (Cantwell et al., 1978).

Legal Framework

In 2003, the Sri Lankan Government approved in the Parliament, the Petroleum Resources Act No. 26 of 2003. The new Act has the necessary legal framework to facilitate private sector participation, both foreign and local, in petroleum exploration in offshore areas under the Sri Lankan jurisdiction. The Ministry of Petroleum Resources Development has come into existence with the new Act. Petroleum Resources Development Committee (PRDC) has been established to make policy decision in petroleum industry in Sri Lanka. Secretary to the ministry of Petroleum Resources Development becomes the chairman of PRDC ex-officio. Other members of the PRDC are

secretaries to the ministries of Power and Energy, Finance, Environment, Natural Resources, Ocean Resources, Fisheries and Defense. Chairman of the Board of Investment (BOI), two nominees from the ministries of Policy Development and Implementation and Petroleum Resources Development also become members of PRDC.

Petroleum Resources Development Secretariat (PRDS) was established and enforced by the Petroleum Resource Act to carry out and regulate all activities related to petroleum industry in Sri Lanka. PRDS also has to assist the PRDC in making policy decisions and is bound by the law to abide by and execute the policy decisions taken by the committee.

First Licensing Round

The Mannar Basin was divided into eight exploration blocks. The Sri Lankan Government has decided to allocate blocks 1 and 8 to Indian and Chinese Governments respectively on unsolicited basis. Cairn India (Private) Limited won the bid for the block No. 2, that is denoted as SL 2007-01-001. The block 2 covers 3,338 square kilometres in water depths of 200 metres to 1,800 metres. July 07th of 2008 is an important landmark in the history of local petroleum industry. On this day, Cairn Lanka (Private) Limited, which is a wholly-owned subsidiary of Cairn India (Private) limited, and the Government of Sri Lanka entered into a Petroleum Resources Agreement, which is a product sharing type of a contract. Provisions in this agreement regulate all activities relating to the petroleum exploration, development and production in the block No. 2 by Cairn Lanka (Private) Limited. Shortly after the two parties entered into the agreement, Cairn offered the Sri Lankan Government a Signature Bonus worth of one million US dollars. Objective of the bonus was to set off the expenditure incurred by the Government for holding the licensing round with road shows that were held at London, Houston and Kuala Lumpur. The Signature Bonus is not obligatory. It is a bid evaluating criterion; therefore its value may change from contractor to contractor.

Exploration period is eight years, which is divided into three exploration phases. During the first exploration phase, Cairn will acquire 5000 kilometer two dimensional (2D), 1000 square kilometer three dimensional (3D) seismic data and drill three exploration wells.

Benefits

Numerous direct and indirect socioeconomic benefits will come to Sri Lanka through petroleum industry. Terms and conditions in the Petroleum Resource Agreement is in such a way that the country could harness maximum benefits of the industry.

Cairn has to commence exploration activities within six months from the date of Exploration License that was awarded to them in October 2008. First and foremost, they will probably acquire 5000 km 2D marine seismic data in the block No. 2. All data acquired by the company are a property of the Sri Lankan Government. However, the company is allowed to retain a copy of the data for exploration purposes.

In case of a discovery of hydrocarbon deposits for an economically viable industry, the company has to develop it into a producing field. Soon after production starts, the company will have to pay the Sri Lankan Government a production bonus that is also a bid evaluating criterion, and therefore, its value may change from contractor to contractor.

The Government is entitled to a ten percent (10%) of petroleum production as royalty and the company is entitled to maximum 70 percent of petroleum produced for recovering the cost of exploration and development (Notice Inviting Offers of the Mannar Basin Licensing Round, 2007). The quantity of petroleum allocated for cost recovery of the company is referred to as Cost Petroleum. The amount of petroleum left after Royalty and Cost Petroleum is referred to as Profit Petroleum. Profit Petroleum is the profit of both Government and the company from petroleum production. The Government share of Profit Petroleum is decided by the Investment Multiple, which is obtained by dividing the annual net cash income of the company by its total exploration and development cost. In the early years of production, the Government share of Profit Petroleum is relatively low, because the Investment Multiple is a low value due to the company's large amount of investment on exploration and development of the field. The Investment Multiple increases with gradual recovery of the company's exploration and development cost, and consequently the government share of Profit Petroleum rises. Rate of profits share against a certain range of value of Investment Multiple is a biddable criterion. Hence, Government profit share may vary from contract to contract. Contractor is subjected to fiscal legislations of Sri Lanka, consequently they need to pay taxes for its share of Cost and Profit Petroleum. These taxes are not on profit basis, but on revenue basis.

A National Oil Company (NOC) will be formed, and participating interest of NOC is a biddable criterion. International oil companies have to stipulate maximum participation interest for NOC in their bids. The minimum participation interest must be 10 percent (Notice Inviting Offers of the Mannar Basin Licensing Round, 2007). At the request of the Government, it can form a consortium company with NOC so that it is entitled to a profit share equal to the participating interest out of Profit Petroleum share of the consortium. NOC also has to pay taxes to the government.

The International oil company is not allowed to export its share of Profit and Cost Petroleum until Sri Lanka becomes self sufficient in petroleum. In other wards, its share of Cost and Profit Petroleum has to be sold in the local market until Sri Lanka could meet its national demand for petroleum.

Contractor has to prioritise Sri Lankan nationals during their recruitments. A necessary training should be given to them and the cost of such training has to be borne by the company. Machinery used in exploration activities has to be purchased from Sri Lanka. Only if they are not available in the country, the company would be allowed to import them.

All exploration activities by the company have to be in accordance with internationally-accepted modern oil/gas field and petroleum industry practices. The company has to take necessary steps to mitigate environmental damage. If the company decided to relinquish exploration activities at the end of any exploration phase, or after in production for several years, the company has to restore the site and decommission all equipment used for exploration, development and production to minimise environmental damage. Apart from all these remedial measures, an Environmental Fund is established and the company has to allocate a fixed amount to the fund annually. The value of fixed amount will vary in exploration, development and production periods. Environmental Fund will be utilised by the Government to facilitate and promote Environmental Research in Sri Lanka. However, Royalty, Signature Bonus, Production Bonus and Environmental Fund are cost recoverable and are recovered from cost petroleum at a rate of 100 percent.

Issues Needed to be Addressed

One of the biggest issues in the industry at the moment is the lack of technically-qualified people in the country. A strategic plan has to be implemented to get the assistance and consultancy of Sri Lankan expatriates employed in overseas petroleum industries. On the other hand, hiring foreign consultants is extremely costly. It is essential to lay the foundation for producing resource persons required for the industry within the country. Hence, courses like Petroleum Geology, Seismic Data Acquisition and Processing, Seismic Data Interpretation, Petrophysics, Basin Analysis, Reservoir Geology, Drilling Engineering and Petroleum Economics have to be introduced to the academic curriculum of local universities. None of the local universities offers these courses at the moment. Firstly, academic entities in local universities, which are more suitable for offering these courses, have to be identified. Geology Department in the University of Peradeniya and the Faculty of Fisheries and Marine Sciences and Technology in the Ruhuna University are the most suitable contenders. Funding has to be allocated to these institutions to purchase necessary infrastructure facilities such as computers and computer software, laboratory instruments, etc. PRDS has to make seismic data available to these institutions so that the undergraduates would have a first hand look at the seismic sections from the Mannar Basin. It will help developing interpretation skills as well as familiarising the geology of the Mannar Basin.

Absence of a proper facility to store field tapes of raw seismic data is also a huge issue. The seismic data acquired by TGS-NOPEC is currently lying in a storage facility in Australia. Obtaining the service of such a foreign storage facility almost on the other side of the globe is very costly. Hence, any interested party has to bear an additional cost including the postage to get a copy of the seismic data. More over, it delays the delivery of data to the interested party due to an additional administrative procedure. Expansion of exploration activities gathers more and more seismic data. It is very important to establish a suitable data storage facility in Sri Lanka with immediate effect. The storage facility should have a well-controlled environment conductive for prolong safety of the seismic data.

There is no workstation in the country to interpret seismic data. Any interested local or international party does not have an opportunity to look at the seismic sections from the Mannar Basin. It prevents any prospective bidder from knowing the petroleum potential of the Mannar Basin. Without demonstrating the petroleum potential of the basin, it would be difficult to attract bidders for future licensing rounds. Hence, it is very important to establish in the country a workstatiqn having seismic data interpretation facilities before the second licensing round.

Already acquired seismic data should be made available to interested exploration companies at a reasonable price. Current price of the seismic data acquired by the TGS-NOPEC is not reasonable. Seismic data is the most important requirement to know the petroleum potential of any prospective basin. One of the main reasons for the lack of response and competition received for the first licensing round may be ascribed to this non affordability of the seismic data.

Petroleum exploration of the Cauvery Basin has to be launched without a delay. A detailed seismic survey will help identify accumulation of commercial petroleum deposits in the basin. Line spacing of such a survey should be not more than 2 kilometres. According to the Geology of the Cauvery Basin, it is difficult to anticipate medium or large-scale petroleum deposits. Several scattered small-scale oil and gas deposits (probably less than 100 million barrels) that may be trapped using high-deviation well from a single offshore platform are more likely (Premarathne, 2008).

Geology of Sri Lanka reveals that there are other prospective areas, other than the Cauvery and the Mannar Basins in the island's coastal belt. It is very important to identify such areas using gravity and magnetic data and extend exploration activities to them. Chances are slim for finding petroleum within the country. Therefore, it is futile to carryout out petroleum exploration within the country.

Conclusions

Unless new petroleum reserves or a successful alternative to petroleum are discovered, there will be a global energy crisis by 2040. Therefore, looking for petroleum deposits in Sri Lankan offshore is a must. Among the two basins, the Cauvery Basin is more promising in hydrocarbon. There are other offshore areas around the country's coastal belt having high petroleum potential to which exploration has to be extended. Petroleum exploration in the Mannar Basin is strongly dependant on crude oil price of the world market. Current low oil price is detrimental to the future of petroleum exploration in Sri Lanka. If petroleum is discovered from the Manna Basin, it will bring a lot of economic benefits to Sri Lanka. However, several important decisions are yet to be made to maximise the benefits. If Cairn Lanka is able to discover petroleum deposit for an economically viable industry during next three years, commercial production could be started probably by 2018.

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