Exploration and Production of Oil and Natural Gas in Marginal Fields

Raíssa Fernandes Yabiko\(^1\), Jéssica Matar Antunes\(^2\), Rosemarie Bröker Bone\(^3\)

Abstract

The objective of this article is to analyze the economic and social impact of oil and gas (O&G) exploration and production (E&P) activities at Alagoinhas (Bahia – Brazil) and Vera Cruz (Bahia – Brazil), where the marginal fields of Bom Lugar and Morro do Barro are located. After initial exploration by Petrobras in the 1990s, these fields were returned to ANP at the Round Zero, and were bided in 2006, during the 7th Round. The production resumption took place only in 2008. Due to the increased hydrocarbons output in both fields, a change in economic conditions of the region happened. Indicators such as the Gross Domestic Product - Added Value (PIBVA) increased; municipalities’ tax revenues were boosted due to O&G royalties. E&P activities stimulated the presence of direct and indirect services providers to the petroleum sector. This scenario made a positive change in the number of people employed, fostering local income and savings possibly. However, investment in social infrastructure is still weak, as health facilities and the number of schools showed no such significant growth.

Keywords: Alagoinhas. Bom Lugar. Vera Cruz. Morro do Barro. Exploration and Production of oil and natural gas.

1. Introduction

Before 1997 the exploration and production of oil and natural gas in Brazil was a monopoly of Petrobras, a Brazilian state-owned company. In that year a new petroleum law took effect; it allowed to private companies to enter in exploration and oil production activities, creating competition in the sector. In the transition period between the establishment of this new legislation and the start of public bidding organized by the National Petroleum Agency (ANP), it took place the "Round Zero". Round Zero was the signing of concession contracts between Petrobras and ANP where it was defined which fields would continue granted to Petrobras, and those that would be put available to ANP place them at auction subsequently.

Some of the areas that were not claimed by Petrobras, already in the production stage or advanced development, became known as "marginal fields" and were bid during the Seventh and Eighth Rounds, with the support of a government policy aimed to encourage the introduction of small companies in oil sector and to develop more remote areas of the country with assets from oil.

The purpose of this article is to verify the economic and social development of a region under the influence of marginal fields. Here we focus on two specific areas; however, the approach employed in this study could be easily extended to a broader research (e.g. in national scale). As study object, we focused in the marginal accumulation of Bom Lugar and its principal municipality adjacent, Alagoinhas, which was chosen because it is the first in oil production marginal field. We also investigated the accumulation of

\(^1\)Undergraduate in Petroleum Engineering, Polytechnic School of Federal University of Rio de Janeiro, Brazil.  
\(^2\)Undergraduate in Petroleum Engineering, Polytechnic School of Federal University of Rio de Janeiro, Brazil.  
\(^3\)PhD in Economics, Professor in Department of Industrial Engineering - DIE, Polytechnic School of the Federal University of Rio de Janeiro.
Morro do Barro (adjacent municipality of Vera Cruz), which presents the higher natural gas production among the marginal fields.

This research employed data from: National Petroleum Agency (ANP), Brazilian Institute of Geography and Statistics (IBGE) and United Nations Development Programme (PNUD). The methodology used these official data to describe the scenario in these regions in order to make possible the comparison between economic and social sector.

2. Marginal Accumulation Fields and Adjacent Counties

Bom Lugar, a marginal accumulation area, is located in the Reconcavo/Bahia Basin. The former field of Bom Lugar started to produce in 1968 and produced until 1997 when it was deactivated and returned to ANP during Round Zero. This area was acquired in 2005, in the 7th Round. Currently the company operating the area is Alvopetro SA Extraction of Oil, and its production was restarted in 2008. Since the beginning of 2012 it is the largest oil producer among the marginal fields. The municipality of Alagoinhas is the main town in the vicinity of Bom Lugar and is located east of the state of Bahia (figure 1). The city houses the Sauipe Industrial Center, and it has the second largest Gross domestic product (GDP) of Bahia and the tenth largest population.

The Morro do Barro area is located in Itaparica Island/Bahia (figure 1). It was active under Petrobras control within the period 1964 – 1988, this premature closure occurred because the main hydrocarbon present was the natural gas, which was not economically attractive inasmuch as there were not enough transmission networks to supply the main consumer centers and its low market price. In 1997 it was returned to ANP during Round Zero and sold in October 2005, in 7th Round to PANERGY Oil and Gas Ltd Company. The production started in 2008, and since the beginning of 2012 it was rated by ANP as the marginal field that produces more natural gas. The municipality of Vera Cruz is also located in the Itaparica Island. Nowadays the basis of city economy is tourism, and it occupies the 68th place in the state's GDP ranking.

Fig. 1Location of Alagoinhas and Vera Cruz (Bahia-Brazil)

Source: Google Maplink (2014)
In order to establish a relationship between economic and social development of the municipalities with the E&P of oil and natural gas in their territories, we analyzed a set of economic and social variables after the period of reactivation of the fields.

3. Economic Variables

In the economic context, the following variables were examined: royalties collection by municipalities between 2008 and 2012 according to the ANP (charts 1 and 2); Gross Domestic Product - Added Value (PIBVA) (charts 3 and 4), which is the contribution to the gross domestic product by various economic activities, according to IBGE data for the period between 2008 and 2010; net budget of municipalities, using as source IBGE data within years 2006-2010; and private savings and employed people (charts 5 and 6), both data provided by IBGE in the period between 2008 and 2011. Right below the charts analyzing some of these variables is shown.

![Chart 1: Royalties in Real (Million) – Alagoinhas](image1)

Source: ANP (2013)

![Chart 2: Royalties in Real (Million) – Vera Cruz.](image2)

Source: ANP (2013)
Chart 3: Pibva - Alagoinhas (Ba)

Source: Ibge (2013)

Chart 4: PIBVA – Vera Cruz (BA)

Source: IBGE (2013)

Chart 5: Employed People – Alagoinhas (BA)

Source: IBGE (2013)
First analyzing the municipality of Alagoinhas, it can be concluded that under the economic perspective every variable showed improvements. The collection of royalties increased 43% during the production period, yielding an increase in revenues collected by the city that changed its cash flow from a deficit to a surplus condition; this positive situation induced a rise in PIBVA values of all sectors, mainly in the industrial and service. This scenario is a result of the stimuli to the presence of oil industry in the region, which brought companies providing direct and indirect services in the oil sector. It had an immediate effect of positive change in salaried staff, which grew 51%, and as a further proof of enrichment at Alagoinhas, saving of the population increased 204%, causing the opening of a new bank branch.

In the municipality of Vera Cruz it was not different. With respect to royalties, Vera Cruz had an increase of about 6000%. Although this value is pretty significant, it is necessary to consider that the municipality had no previous relevant oil economy, and thus, any minimum gain influence the rate significantly. The evolution of the PIBVA followed the trend of Alagoinhas, also showing positive growth, the only contrast is that in Vera Cruz the industry sector is not much important which make sense in view of the main economy in this county is the tourism and the natural gas production does not require a strong industrial sector around. Furthermore the net city budge became surplus in 2010 which was followed by the population enrichment that can be seen by analyzing the private savings which also got a boost of 308% associated with the favorable economic moment. On the other hand, employment rates and listed companies have not followed the same pace. This is due to the fact that the biggest promotion of the oil industry is in the production chain. Once that Morro do Barro's main hydrocarbon is natural gas, no significant hiring of qualified local workforce occurred.

4. Social Variables

In the social sphere, the following variables were analyzed: Gini index, which measures the degree of inequality in the distribution of individuals according to per capita household income; the City Development Index (CDI), a parameter that analyzes how education, income and health have evolved over the years; the infant mortality rate; and the City Development Index in the Education Perspective, which is a composite of indicators of schooling of the adult population and school flow of young population and assesses the literacy rate and frequency of the student. These data were made available in the Atlas of Human Development in Brazil by UNDP between 1991 and 2010. Using as a research tool also IBGE, other variables were also analyzed: health facilities and available beds in the counties between 2005 and 2009; and school units and students enrolled during the period between 2005 and 2012.

There are several indices that show the human development of a locality. The first index considered is the Gini index, which measures the degree of inequality in the distribution of individuals according to per
capita household income. Its value ranges from 0, when there is no inequality, to 1, where the maximum inequality is (one individual has all the income). The universe of individuals is limited to those living in permanent private households. The chart 7 shows the data obtained.

**Chart 7: Gini Index - Brazil vs. Alagoinhas And Vera Cruz**

![Chart 7: Gini Index - Brazil vs. Alagoinhas And Vera Cruz](image)

Source: PNUD (2013)

Both counties have a Gini coefficient lower than the national average, which is a positive aspect. Alagoinhas presents a progressive improvement in income inequality in the region. The municipality of Vera Cruz during the years 1991 and 2000, when the field of Morro de Barro was closed, income inequality among residents increased and subsequent years, when the E&P of oil and natural gas was reactivated, there was a decrease the Gini index.

Up to here, the data was related more to the economic situation of the counties. Now, is going to be analyzed how the surplus funds that goes into the coffers of the municipalities is being spent and whether it is reversed in benefits to the population through public spending on education and health in order to promote the development and improvement of life.

**Chart 8: CDI - Brazil vs. Alagoinhas and Vera Cruz (BA)**

![Chart 8: CDI - Brazil vs. Alagoinhas and Vera Cruz (BA)](image)

Source: PNUD – 2013
The City Development Index is the most important variable that looks at how education, income and health, combined, have evolved over the years, giving more importance to quality of life than to economic variables. In chart 8, data obtained in Alagoinhas and Vera Cruz are compared with the national average.

Just as the national average, the CDI of these municipalities in Bahia has also grown over the years; however, remain below the national average, a factor that justified why much of the municipal rates, discussed below, are lower than expected which makes the need for investments in this poor areas even more urgent.

In the health sector, the firsts variables considered are the health facilities as (hospitals) and available hospitals beds. In Alagoinhas and Vera Cruz the only improvement noticed was the increased of private hospitals, which means that the demand that should be remedied by the government has fallen in the private sector.

![Chart 9: Infant Mortality Rate – Brazil vs. Alagoinhas and Vera Cruz (BA)](source: PNUD – 201)

Continuing in this perspective the infant mortality rate shows a little different scenario. In the chart 9 is possible to notice that both counties are above the nation average rate, which is a terrible situation which may be explained by the health system still very precarious, natural adversities like drought, and CDI below average. However the most interesting data is that Vera Cruz’s improvement was more significant than Alagoinhas (that is 3 times bigger than Vera Cruz in the economic conditions) which can be a result from a weak administration by the city hall creating a fragile health system.

Other alarming data are obtained when analyzing the education sector. Investment in education is still undervalued, which was observed when it computes the number of schools and regular students in Alagoinhas and Vera Cruz. According to IBGE (charts 10 and 11) was a general decreased. The number of schools pulled back in both counties, as the number of the regular students. To compare the development of education in municipalities with a national average, there is the CDI focused on education (chart 12), which is a composite of indicators of schooling of the adult population, the school flow of young population, literacy rate and frequency of the student. Under this perspective both cities present a growth during the years (1991-2010), but they still figure below the nation rate. However, this index does not depict the actual situation of education in the city, bearing in mind that the variables it considers tend to mask the real lack of infrastructure.
Chart 10: Schools and Regular Students – Alagoinhas (BA)

Source: IBGE (2013)

Chart 11: Schools and Regular Students – Vera Cruz (BA)

Source: IBGE (2013)

Chart 12: CDI-E Brazil Vs. Alagoinhas And Vera Cruz

5. Conclusion

Based on the data acquired we can conclude that the reactivation of marginal fields Bom Lugar and Morro do Barro, located in the municipalities around Alagoinhas and Vera Cruz (BA), respectively, caused changes in the economic and social dynamics of these cities. In both municipalities analyzed, Alagoinhas (second largest GDP of Bahia) and Vera Cruz (small town located in a tourist island), there is a trend.

Economically, the reactivation of the activities of the oil sector in the region boosted the industry, generating jobs and collaborated with the increasing profit of the public treasury. However, to an industry sector contribute to the improval of life quality and development of a locality, social indicators should demonstrate positive changes at least in the same proportion of the rising incomes and the incentive that comes from oil. Unfortunately, this economic improvement was not reflected for the population. Under the social standpoint the results were not satisfactory once that the growth rate of economic indicators were much higher than the growth rate of social indicators that repeatedly gets to be negative in both counties.

This analysis presented collaborates with the understanding of some government measures such as the Social Fund, and the regulation by law of the royalties destined for education and health, since these sectors, which should be the main beneficiaries of government revenue are repeatedly ignored.

References

