DEVELOPMENT AND MANAGEMENT OF MARGINAL OIL FIELD IN THE NIGER DELTA BASIN: OPPORTUNITIES AND CHALLENGES

By
U. S. Offia
Petroleum Engineering and Geosciences Department
Petroleum Training Institute, Effurun
Delta State. Nigeria

Published in:
Petroleum Technology Development Journal (ISSN 1595-9104)
An International Journal

July 2011 - Vol. 1
Abstract
The Federal Government of Nigeria, initiated the development program of the Marginal Oil Field (MOFs) in the Niger Delta region to increase production, reserves, employment, and indigenous participation in oil and gas business. Development of MOFs is challenging owing to the capital intensive nature of petroleum production, geological complex formation, and government policy. The cost of infrastructure continues to soar and it requires prudent project economics to bring down the cost. The security issues of the region are receiving attention by the Government and there is regulatory law for investment cash inflow and outflow in Nigeria. However there are opportunities great benefits in investing in MOFs in the region. This paper examines the challenges and these opportunities.

Introduction
Petroleum exploration started in Nigeria in the 1930’s. Since then many oil fields termed Marginal Oil Fields (MOFs) have been left undeveloped by the multinational oil companies because the volume of oil in them does not fit into their commercial targets and programmes. The Federal Government of Nigeria in a bid to give opportunities to the small indigenous production companies and to increase oil production passed a legislation to provide for the production of the MOFs. Marginal Oil Field is defined as an oil field that does not produce enough net income to make it worth developing at a given time. If the technical and the economic conditions change, the field becomes commercial. 

Apart from low oil reserve, other characteristics of MOF include geologic, economic and technological constraints, lack of nearby existing production facilities to put on stream, unfavourable market and fiscal situations, poor or unfavourable crude characteristics e.g. high crude viscosity, a field with few or one well undeveloped for about 10 years by the multinational oil company (MOC), a field that may still have reserve but uneconomical for development by the MOC, and a small field that may not produce up to 10,000bbls of oil per day.

The reasons given by the federal government for introducing the marginal field regime include:
- Increasing oil and gas reserves: By developing marginal oil fields in the country, both oil and gas reserves will be increased.
- Increasing indigenous participation in the oil and gas industry: The law reserves the marginal oil fields for only indigenous participation. This will lead to technology transfer in the oil and gas industry.
- Employment generation: Participation of indigenous companies in developing marginal oil fields will generate employment for highly skilled Nigerian professionals and people in the host community.
- Increasing production: Initiating the MOF development will lead to increase in crude production, as the crude produced from the fields will be added to the national oil production quota.

---

1 Petroleum (Amendment) Decree No. 23 1996 which amended The Petroleum Act, Laws of the Federation of Nigeria 1990, by introducing Section 16A (3)(a) that provides for Marginal Oil Fields
3 Department of Petroleum Resource (DPR) Guidelines for the Farm-out and Operations of Marginal Fields. 1996.
Scope of participation: Operation of the MOF will increase and expand the scope of participation of indigenous oil companies in oil and gas business in the country.¹

Location of MOF in the Niger Delta Basin
MOFs in the Niger Delta Basin are scattered in the oil producing states in the Niger Delta Area. These areas include Edo, Ondo, Delta, Bayelsa, Rivers, Akwa Ibom, Cross River, Imo and Abia States. The fields contain several reservoirs at different depths with total oil reserve of 1.3 billion barrels. In 1999 the Nigerian Department of Petroleum Resources identified 116 marginal oil fields. At the end of the bidding that was conducted for these fields, 24 operating licenses were awarded to different indigenous oil companies, as shown by the map of the area and the list of reserves. The MOFs are expected to improve the Nigerian oil reserves which stood at 36.2 billion barrels as at January 2007, hoping to reach 40 billion barrels by 2010.²

Leasing of MOFs and Regulatory Laws
Right from the start of oil exploration in Nigeria, some fields were termed marginal oil fields due to their low economic returns. In 1999, the Government declared its intention to develop these marginal fields through qualified indigenous oil companies. In 2003, a tripartite agreement was reached between the MOC, Federal Government and the indigenous oil companies that were ready to develop these fields.³ The agreement was based on the understanding of the implications of the amendment to the Petroleum law that made it possible to classify the marginal fields and make it possible for the small indigenous oil producing companies to be able to produce them. The understanding was that under the new law:

1. A concession holder may farm out a marginal field situated upon its concession, with the approval of the head of state as to the farm out terms and conditions.
2. The head of state is empowered to farm out a marginal field if the field has been left unattended for a period of not less than 10 years from the date of its discovery.
3. The head of State alone may classify fields as marginal for the purpose of the law.
4. The head of state shall not approve of a farm out arrangement or cause a marginal field to be farmed out unless it is in public interest to do so; and in addition, in the case of a non-producing marginal field, that the marginal field has been left unattended to for a reasonable time not less than 10 years; and the parties to the arrangement are agreeable to the Federal Government.⁴

Department of Petroleum Resources (DPR) Regulations
To ease the procedure for the operation of marginal field, the Department of Petroleum Resources (DPR) issued Guidelines for Farm-out and Operations of Marginal Oil Fields. The Guidelines provide that:

1. Current holders of Oil Prospecting License and Oil Mining Lease (OPL/OML), except indigenous oil companies are excluded from farming into marginal oil fields. Indigenous Companies must relinquish existing OPL/OML to be eligible.
2. Only companies incorporated in Nigeria that are 51% Nigerian owned are eligible to bid and applicants should not bid for more than one field.
3. Marginal fields may only be operated on a “Sole Risk” basis. The agreement shall be for an initial period of 5 years, renewable thereafter every 5 years until the expiry of the lease.
4. A marginal field holder may have a foreign technical partner with not more than 40% interest in the marginal field.

² United State Energy Information Administration, Nigeria
⁴ See Petroleum (Amendment) Decree No. 23 1996 which amended The Petroleum Act, Laws of the Federation of Nigeria 1990, by introducing Section 16A (3)(a) that provides for Marginal Oil Fields
5. Various fees, Premium, Rents and Royalties are prescribed, while Petroleum Profit Tax is charged at the rate of 65.75%.

6. Where a field is farmed out, the marginal field holder is obliged to pay the original owner the entire fee in instalments over a maximum period of 5 years. The fee payable is the present day value of the previous exploration cost as determined by both parties. (But this has been amended to payment of overriding royalty interest to the original lease holder).  

**The Technical or Development Plan**

The Technical or Development Plan must address the following:

- Status review of the field, this will involve a brief overview of the field and the available data, highlight the present status, key characteristics and uncertainties.
- Geological and Geophysical assessments of hydrocarbon bearing formations.
- Reserve Estimation and Production Forecast of the recoverable oil, expected production rate of oil, gas and water.
- Well Engineering of both the existing and new wells, work over well and well locations.
- Crude Treatment will include processing, treatment facilities, transportation and disposal of effluent.
- Operation and Maintenance Policies and their applications in the field.

**The Commercial or Economic plan**

The Commercial or Economic plan must address the following:

- Provide the economic analysis for the life cycle of the field from investment to abandonment.
- Estimate operation and capital cost as per field development and any cost involved.
- Crude and Gas prices will include the cost estimate used in the company economic assessment or evaluation before development of the field.
- Hydrocarbon Tariff Assumptions; these will include details of crude and gas handling charges.
- Decommissioning and Abandonment costs, to include cost of abandonment and tax.
- Royalty and Tax payments will entail tax rate, levies, penalties etc.
- Commercial agreements with other partners, e.g. technical, financial and commercial partners.
- Insurance costs; these will include proposed insurance agreement and estimated costs.
- Cash flow projections and key economic indicators; these shall include projected cash flow after tax, over the full life cycle of the field for the various stakeholders, considering changes in oil prices, key economic factors and fiscal legislation.
- Sensitivity Analysis; this will entail key uncertainties and risk and their potential effects on the economy.
- Financial plan will outline field development and business financing, sources or evidence of financial robustness and risk management.

---

Health, Safety and Environmental (HSE) Aspects of the Bid.

- These outline the HSE Philosophy of the Company and how to apply them at each stage of the operation.
- The Company’s organizational plan should state the manpower and services required.
- Community Development and Local content should include proposed plan to develop the community, participation and engagement of the local community workers.
- Implementation should outline when to start each key project, logistical issues and plan for high level contract.
- Emergency Response should entail response plan, equipment and arrangement for security of the company’s personnel and assets.

Challenges of MOF Development in the Niger Delta Basin

Apart from the differences in geological formations, the operators of MOF have similar challenges all over the world. The operators or licensees are usually small companies that have little investment capital and assets in the oil and gas industry. They face serious challenges in virtually all the developmental stages of the fields. These challenges are project financing, technology, geological complex formation, cost of development and government policy.

Finance: As stated above these companies have limited assets and finance to operate and participate effectively in the business. It is estimated that a marginal field in the Niger Delta Basin will cost about US$40 to US$70mm as development cost for a few years. Foreign technical or financial partner will in most cases contribute 40% of this amount. The government has therefore opted to use the Joint Venture Agreement, Production Sharing Contract and Service Contract to finance the operations.

Other ways that MOF operators can raise funds is by going to the capital market to raise funds. They can in the alternative involve private investors including foreign financial and technical partners through private issuance of shares. The MOF operators may also approach international banks, foreign equity partners, The World Bank, regional bank and financial institutions.

Technology: Technology is another challenge of the MOF operators as the existing technologies are expensive, but changing the technical and economic conditions of MOF can increase return on investment. MOF operators should therefore be prudent in their choices of technology. There are technologies that can be cost effectively applied by the MOF operators to increase return on investment e.g. Extended reach, Infill drilling, Slim-hole drilling, Coil tubing, Down hole electric submersible pump, Surface multiphase pump, Intelligent well completion, Lease production facilities –a-fit-for-purpose production facility on a leased operated and maintained basis.

Geological Complex Formations: In some situations (e.g. as in Malaysia), there could be experience of geologically complex or difficult to produce reservoirs, challenging drilling environment and infrastructure constraints. These situations are also present in Nigerian fields apart from the complex geological situation. In the Niger Delta Basin the geology of the area has been studied and known and exploration activities have shown hydrocarbon reservoirs scattered over the entire area both onshore and offshore or deep water offshore.

However new technologies like snake or undulating up or down horizontal technology and well trajectory have been developed to drill complex reservoirs to optimize production.

---

**Development Cost of Infrastructure:** MOFs should be developed with good development and management economics, strictly to increase recovery and avoid risk or waste. In most cases the development cost of materials, fabrication yards, construction of barges, drilling and environmental concerns, continue to escalate and all these reduce return on investment for the operators.

**Government Policy:** Government policy is the back bone of oil operations world wide, therefore it is necessary for the Government to evolve policy that will create an enabling economic and technological environment for the effective participation of the MOF companies in petroleum exploration and production. There should be a special contractual agreement or regime between the Federal Government, State Government, Local Government, Host Committee, Indigenous oil Companies and the Multinational Oil Companies, that is exclusive to operation of MOF in the Niger Delta Basin.

If there are good policies implemented and respected by all stakeholders, it will take care of youth restiveness, local content, incentives and quota restriction in operating MOF.

**Opportunities of MOF Development in the Niger Delta Basin**

There are many opportunities for the operators of MOF in the Niger Delta Basin and all the stakeholders, indigenous oil companies, technical and financial partners, host communities and above all, Nigerians will benefit from the development of the MOFs. The Federal Government aiming at increasing production rate to 4 million barrels/day to achieve vision 2010 launched the MOF Development programme with its laudable objectives as discussed earlier. We can say authoritatively that:

1. Today there are about 200 MOFs indicated in the Niger Delta Basin and there are ample opportunities in developing these fields.\(^{11}\)
2. The fields have reserves range of 1-5 million barrels of oil. This will definitely guarantee return on investment in short term for the investors.
3. The Niger Delta Basin has familiar geological structures and therefore exploration and field development would be relatively easier than some other zones with complex geological structures.
4. Hydrocarbon reservoirs are scattered all over the region onshore, offshore and deep water offshore.
5. In Nigeria there is availability of high level technical manpower with oil industry experience.
6. The Federal Government has put regulatory laws in place for investment inflow and fund out flow for technical and financial partners.
7. The security issue of the region is receiving adequate attention and indigenous companies are eager to work together with overseas partners to explore the region.

**Developing and Managing Marginal Oil Fields in the Niger Delta Basin**

**Reserves**

Today Nigeria has about 36 billion barrels of oil reserves and the Federal Government aims at increasing this to 40 billion barrels and production rate to 4 million BOPD by year 2010. In 1999, the 116 MOFs identified had about 1.3 billion barrels of proven oil reserves and the Fed Government awarded 24 MOFs to 31 Companies. These fields will contribute between 2000-4000 BOPD to guarantee an increase of the national production rate by 48000-96000 BOPD.

Of recent, about 10 billion barrels unexplored oil reserves have been identified with about 6 billion barrels in deep offshore bringing the total to 16 billion barrels of oil reserves.\(^{12}\) This will increase the Country’s reserves to over 40 billion barrels of oil; it is a good opportunity for investors.

**Technology**
In the oil and gas industry there is availability of new technologies for exploration, production, drilling and reservoir management. Drilling has developed into slim hole drilling, horizontal and extended reach drilling technologies with recent design in drilling bit and other equipment. Production and well completion also developed into smart or intelligent well completion. Cost effective technology should be selected for quick return on investment.

**Economics**
Project economics is one of the important aspects of field development. Investors’ success is based on the correct estimation or evaluation of investment opportunities. It also serves as a bridge between the technical staff and the management, based on the overall financial impact of investment opportunities in the organization. Complete economic evaluation is a vital requirement for sales, mergers, acquisitions, estate settlement, and litigation, financing exploration and field development.

To develop a marginal oil field in the Niger Delta, it will take about $40m- $70m per year, as cost of development for the first few years and the total funding will be about $1-1.2 billion. But based on cost effectiveness of the technology to be used, prudent economic planning and management structure, this cost can be pruned down.

**Development of MOFs in the Niger Delta Basin**
The Federal Government of Nigeria, in line with the stated objectives of developing MOF in the Niger Delta Basin, is encouraging the indigenous oil companies with foreign partners to take up licenses to develop the fields. To develop MOF in the Niger Delta, there are availability of manpower, both Nigerians and foreigners, the geology of the basin is well known, modern technology is available e.g. the extended reach wells. Two wells could be drilled first and production could be tied to nearby production facilities. Generally, it requires good drilling, production, depletion and management planning.

**Management of MOFs in the Niger Delta Basin**
Management of MOF should require serious attention so that minimum investment could pay back maximum profit; therefore this needs integrated reservoir management. This is not only to create development and depletion plans, but a comprehensive integrated strategy for reservoir exploitation. Integrated Reservoir Management can be viewed as a set of decisions and operations, by which a reservoir is identified, measured, developed, produced, monitored and evaluated from its discovering stage through depletion and abandonment. Marginal oil fields being small and low producing fields may require problem solving approach of integrated reservoir management.

In this case an action plan for evaluating and increasing the net worth of investment is prepared by selecting a group of personnel who will systematically work together as a well coordinated basketball team, rather than a relay team. This will also require a simple organogram of the operating company which may involve Managing Director, Manager Operations, Manager Finance, Team Leader and staff.

It is an established fact that reservoir management plans are more productive when geoscientists and engineers in a synergistic approach work together, based on the available technology and sound economic plan.

---

12 Ibid
Conclusion
We have seen that there are about 200 MOFs identified in the Niger Delta Basin with reserve range of 1-5 million barrels of oil. A major constraint in the development of these fields is finance and funding. The problem of funds could be solved by sourcing for funds internally and externally from financial institutions or foreign partners. We are also aware of existing technologies like multilateral well drilling, intelligent well completion etc which could be cost effectively used to increase production. The geology of the basin is well known, reducing the challenges usually associated with such fields.

Management of MOFs may require problem solving approach of integrated reservoir management by preparing an action plan for evaluating and increasing the net worth of investment by a group of people working together as a team. The organizational structure should be simple. For example a Managing Director, Operations Manager, Financial Manager, Team Leader and adequate operations personnel. All these will assist in controlling the overall cost of production and increase the profit margin.

Good government policies and patriotic implementation and enforcement of the policies coupled with peace and security in the region will further sustain a conducive environment for the production of the marginal oil field in the Niger Delta region.

Chart 1

COMPANY ORGANOGRAM

MD

SEC

MO

T leader

Staff

MF

Staff

MD: Managing Director
MO: Manager Operations
MF: Manager Finance
T: Team Leader
Staff: Staffers
Sec: Secretary
**LIST OF NIGERIAN MARGINAL OILFIELDS AND RESERVES**

<table>
<thead>
<tr>
<th>FIELD</th>
<th>OML</th>
<th>RESERVES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(MM BBLs)</td>
</tr>
<tr>
<td>Asuokpu/Umutu</td>
<td>36</td>
<td>16.0</td>
</tr>
<tr>
<td>Asaramatoru</td>
<td>11</td>
<td>7.1</td>
</tr>
<tr>
<td>Ataia</td>
<td>46</td>
<td>2.4</td>
</tr>
<tr>
<td>Eremor</td>
<td>46</td>
<td>3.9</td>
</tr>
<tr>
<td>Ibigwe</td>
<td>16</td>
<td>17.2</td>
</tr>
<tr>
<td>Ofa</td>
<td>30</td>
<td>5.2</td>
</tr>
<tr>
<td>Ozara</td>
<td>11</td>
<td>7.3</td>
</tr>
<tr>
<td>Qua Ibo</td>
<td>13</td>
<td>13.1</td>
</tr>
<tr>
<td>Stubb Creek</td>
<td>14</td>
<td>18.4</td>
</tr>
<tr>
<td>Tom Shot Bank</td>
<td>14</td>
<td>8.6</td>
</tr>
<tr>
<td>Tsekelewu</td>
<td>40</td>
<td>2.2</td>
</tr>
<tr>
<td>Uquo</td>
<td>13</td>
<td>14.2</td>
</tr>
<tr>
<td>Ororo</td>
<td>95</td>
<td>5.65</td>
</tr>
<tr>
<td>Akepo</td>
<td>90</td>
<td>3.9</td>
</tr>
<tr>
<td>Ogedah</td>
<td>90</td>
<td>7.4</td>
</tr>
<tr>
<td>Ajapa</td>
<td>90</td>
<td>4.6</td>
</tr>
<tr>
<td>Dawes Island</td>
<td>54</td>
<td>1.4</td>
</tr>
<tr>
<td>Ke</td>
<td>54</td>
<td>5.5</td>
</tr>
<tr>
<td>Oriji</td>
<td>88</td>
<td>4.0</td>
</tr>
<tr>
<td>Eke</td>
<td>88</td>
<td>3.0</td>
</tr>
<tr>
<td>Umusadege</td>
<td>56</td>
<td>49.3</td>
</tr>
<tr>
<td>Obodogwa/Obodetì</td>
<td>56</td>
<td>4.8</td>
</tr>
<tr>
<td>Umusat/Igbuku</td>
<td>56</td>
<td>6.7</td>
</tr>
<tr>
<td>Amoju/Matsogo/Igbolo</td>
<td>56</td>
<td>6.9</td>
</tr>
</tbody>
</table>