IMPACT ASSESSMENT CASE STUDIES FROM SOUTHERN AFRICA

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SASOL'S OFFSHORE GAS EXPLORATION PROJECT BAZARUTO, MOZAMBIQUE

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Aims of the Project

In accordance with Mozambique's policy to promote international investment in the offshore hydrocarbon industry, an Exploration and Production Concession Contract (EPCC) was signed with Sasol Petroleum Sofala Ltd (hereafter referred to as Sasol) and Emperesa Nacional Hidrocarbonetos (ENH), E.P. The EPCC contained the rights to conduct hydrocarbon exploration and production activities in offshore Blocks 16 & 19, Mozambique (Figure 1). Sasol and ENH's proposed project comprised exploration activities by conducting 2-dimensional (2D) and 3-dimensional (3D) seismic surveys, followed by exploration well drilling and testing.

The seismic surveys were intended to delineate the extent of potential hydrocarbon reserves, while drilling and well testing were to investigate whether the reserves contained hydrocarbons in commercially viable quantities. Sasol appointed Environmental Resources Management Southern Africa (ERM), in partnership with Consultores Associados Lda (Consultec), to undertake the Environmental Impact Assessment (EIA).

Brief description of the development and alternatives considered

Blocks 16 and 19 are located offshore of Inhambane and Sofala Provinces, Mozambique (Figure 1). The main coastal towns in the area are Vilankulos and Inhassoro. Within Blocks 16 & 19, a Shallow Water Prospect and a Deep Water Prospect were identified based on results of previous geophysical surveys. The Shallow Water Prospect area was closer to shore in water depths from 5 to 20 m, while the Deep Water Prospect was located further east in water ranging from 300 to 800 m deep. Seismic surveys were initially planned to take place between April and November 2006, followed by exploration well drilling and well testing activities between April 2007 and November 2008.

Approx 50m isobath which distinguished the shallow water from the deep water. All activities west of the 50m isobath were postponed.

Stage 1: Seismic activities

Seismic surveys are carried out in the investigation of sub-sea geological formations during oil and gas prospecting. High level, low frequency sounds are directed towards the seabed from near-surface sound sources that are towed by a ship.

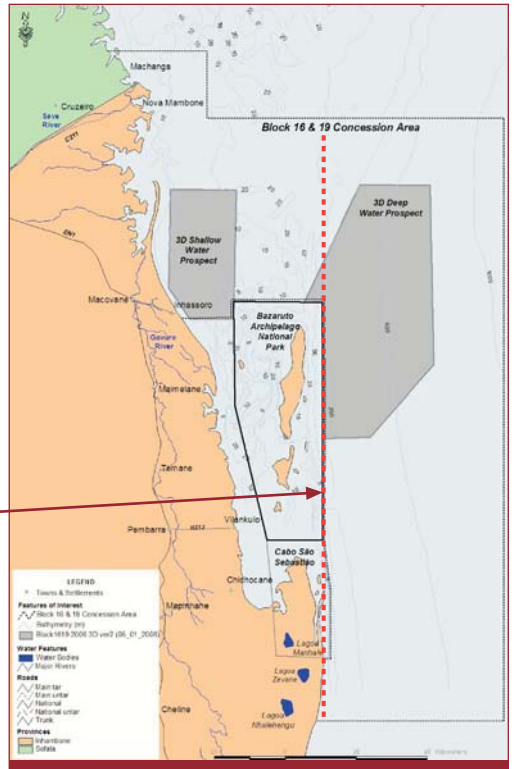

Figure 1: Locality Map showing Blocks 16 & 19 and the 3D Deep and Shallow Water Prospects

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Brief description of the development and alternatives considered

Signals reflected from geological discontinuities below the seafloor are recorded by hydrophones mounted inside streamer cables that are either towed by the seismic vessel or laid on the seafloor. The recorded signals are transmitted to the seismic vessel for electronic processing. Two seismic surveys, 2D and 3D, were planned in offshore Blocks 16 and 19, totalling an area of approximately 10,000 km^2. The 2D programme was planned to cover the entire extent of Blocks 16 and 19 and was expected to take one month, while the 3D survey was planned for the Shallow and the Deep Water Prospect Areas over a four month period.

Stage 2: Exploration drilling & well testing activities

Exploration drilling and well testing operations are undertaken to determine whether subsurface geological structures contain hydrocarbons in potentially commercial quantities. Three exploration wells were planned, one in the Shallow and two in the Deep Water Prospect Area. Each well was expected to take 15 to 25 days to drill to a depth of 2,200 m. It was estimated that in the event of a discovery, a further 6 to 10 days would be taken to test the well. This test would involve flowing hydrocarbons to surface and flaring them through custom-made offshore burners.

Figure 2: Semi-submersible Drilling Unit and standby boat during deep water exploration drilling, with Bazaruto Island in the background

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Brief description of the development and alternatives considered

Support operations

Support vessels (e.g. crew and supply boats) are required to support offshore seismic and drilling operations, including helicopter support. Beira was the nearest port able to supply these services, and no new facilities would be required there. In turn, the Vilankulos International Airport was utilized to transfer international personnel.

Potential impacts

Aspects of seismic survey and drilling activities which have environmental impacts include emissions, discharges, noise, solid waste, seafloor disturbance and spatial exclusion, personnel requirements and local employment.

- ***Emissions:*** Greenhouse gases and air pollutants are emitted during exploration activities and gas flaring operations, including carbon monoxide (CO), oxides of nitrogen (NOx) and sulfur (SOx), volatile organic compounds (VOCs) and particulate matter.

- ***Discharges:*** Discharges associated with the operations include drilling fluids (muds) and cuttings, gray and black water, bilge water, deck drainage, ballast water, garbage, and miscellaneous wastes.

- ***Noise:*** Low frequency, high level underwater sound emitted during seismic surveys can have physical and behavioural impacts on marine fauna, including plankton, fish and marine mammals. These sounds could also potentially impact on humans during underwater activities such as scuba-diving. Furthermore, drilling activities and increased support vessel traffic introduce more noise into the marine environment.

- ***Seafloor Disturbance:*** Depending on the seismic acquisition method used, laying seismic cables in the shallow water could disturb the seafloor and sensitive benthic communities such as reefs. Drilling activities would result in physical disturbance of the seafloor as a result of the physical footprint of a drilling vessel such as a jack-up rig or drill barge in shallow water, anchor laying and discharge of cuttings.

- ***Spatial exclusion:*** During the seismic surveys, an exclusion zone was to be enforced where no fishing boats or ships are allowed within 5 km from the seismic vessel. While the drilling vessel is operational, a temporary 500 m statutory exclusion zone around the vessel was to be in force. If a drilling vessel employing anchors was used, a safety exclusion zone of 1,500 m would be implemented around the drilling vessel.

- ***Employment:*** Seismic vessels, the drilling rig and support vessels were sourced from the international market, including related equipment and specialised personnel. As a result limited local labour was to be employed for the project.

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Environmental setting

Blocks 16 & 19 are located offshore of the Bazaruto Archipelago which forms part of a larger bioregion known as the Western Indian Ocean that includes the coastlines of Somalia, Kenya, Tanzania, Mozambique and South Africa and various islands. The Western Indian Ocean region is home to some of the world's most important coastal and marine resources. The warm water provides suitable habitat for a rich and diverse variety of marine fauna and flora, including approximately 1,000 kinds of seaweeds, over 200 coral species, more than 3,000 species of molluscs and over 52 tropical inshore fish families, 22% of which are endemic.

In the Bazaruto area, at least 12 species of whales and dolphins have been recorded. Humpback whales utilise these waters as a migratory corridor between their summer Antarctic feeding and breeding grounds in the warm coastal waters.

Figure 3: Humpback whale breaching east of Bazaruto

In addition, the largest remaining viable population of dugongs in the Western Indian Ocean Region occurs here. Ecologically important coastal and marine habitats in the Bazaruto area include beaches and coastal mud flats, extensive mangrove forests, coral reefs and open waters. These habitats provide important nesting and foraging grounds for various species of turtles and other marine fauna.

The Bazaruto National Park was established in 1971 and tourism is an important component of the local economy. Specifically, the Bazaruto-Vilankulo area has been identified as a Priority Area for Tourism Investment in Mozambique. International and regional tourism operators have lodges and hotels in the area offering sailing, recreational fishing and diving. The coastal and marine environmealso supports the livelihood of impoverished inhabitants. A large proportion of the local population is either directly or indirectly involved in artisanal fishing activities, and many of the inhabitants rely on marine resources for food. Semi-industrial and industrial fisheries also frequent shallow and deep waters within the project area.

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EIA process followed

The EIA followed the standard process comprised of scoping, specialist studies, impact assessment and the drafting of management plans. The process was designed to meet Mozambican regulatory requirements and international best practice.

Adaptability during the Scoping Phase

During the Scoping Phase the EIA team identified information gaps regarding key sensitivities including the existence of a threatened resident dugong population, the sensitive artisanal fishery and the extent and importance of the local tourism sector. As a result, the Terms of Reference of the marine ecological study were extended to include aerial surveys of the concession area to confirm the numberand distribution of dugongs in the area. The Terms of Reference for the socio-economic study were extended to include more detailed studies on the tourism and artisanal fisheries sector. This information allowed for a more detailed understanding of the sensitivities of the affected ecological and socio-economic environment which later proved to be critical in terms of key recommendations made in the EIA.

Stakeholder engagement process

The stakeholder engagement process needed to be designed in a way to communicate to a cross - section of cultures and socio-economic classes. Various techniques were used to achieve this. Firstly, communication was carried out in at least three different languages, namely English, Portuguese and local dialects. Various techniques were used to disseminate information. A brief non-technical Background Information Document (BID) was distributed to all stakeholders in the Scoping Phase, aimed at sharing information with stakeholders ahead of the public meetings. The BID was issued in Portuguese and English with the aim of 1) introducing the purpose and need for the proposed project 2) describing the EIA process and 3) describing the project and potential environmental and social impacts.

Figure 4: Public meeting held in Inhassorro during the project implementation phase

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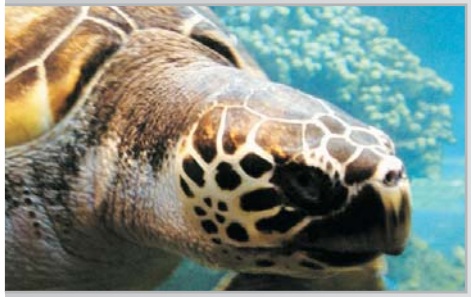

EIA process followed

Radio adverts, press notices, letters and direct communication with community leaders (in Portuguese, English and local dialects) were used to announce various public meetings. Public meetings were held at three distinct stages of the EIA process: during scoping to present the proposed project to affected stakeholders and to identify issues of concern; to present the results of the Draft Scoping Report; and to present the results of the Draft EIA Report. A total of 15 public meetings were held throughout the process with simultaneous translation being used at the majority of meetings. Poster displays were used to better communicate the project and the results of the Draft Scoping and EIA Reports. Both reports were translated into Portuguese, lodged on an English/Portuguese website and distributed for public comment for a period of four to six weeks. Non-technical summaries of both reports were also compiled and translated. To ensure that the affected stakeholders, most whom were poorly literate, understood and were able to comment on the Draft Environmental Impact Report, its key contents were workshopped with the stakeholders. A Comments-Response Report was compiled providing detailed responses to all issues raised.

Stakeholder Forum

During the Scoping Phase it became evident that the level of interest and potential for conflict surrounding the proposed development and EIA process were high. Stakeholders requested that they be allowed to engage more closely with the EIA team. The proponent agreed to fund the establishment of a formal Stakeholder Forum. This allowed for a representative group of stakeholders to closely monitor the EIA process through closer discussion with the EIA team and the proponent. The Forum became the principal communication channel between the interested and affected parties, the proponent and the EIA team, contributing significantly to the establishment of strong relationships between the parties. This important foundation was built on during the project implementation where the stakeholder engagement principles adopted in the EIA phase continued to be applied.

Figure 5: Stakeholder Forum meeting in Inhassoro during project implementation.

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EIA process followed

Terms of Reference (ToR) were developed for the Forum. These were presented and discussed at three public meetings held at key locations throughout the project area prior to the Forum's establishment. The final ToRs included key aspects for the functioning of the forum, governing:

- The composition of the forum, including representatives of all relevant and potentially affected sectors, selected and mandated by each sector; and
- The responsibility of mandated representatives for ensuring the dissemination of information to their respective constituencies.

In addition, a Stakeholder's Forum sub-group was established in Maputo, including primarily national and international environmental NGOs and larger tourism operators with interests and investments in the project area.

During the EIA process Forum meetings were held in the project area and in Maputo. At each meeting representatives of the EIA team and proponent were present. Preliminary results from the EIA and key decisions were first presented and discussed at the Forum meetings prior to disclosure to the public. Facilitated group discussions were employed to allow Forum members to understand, query and comment on the impact assessment results and proposed mitigation measures. This added credibility to the impact assessment process and gave confidence on the effectiveness of the proposed mitigation measures.

No-go recommendation

During the assessment it became apparent that the potential impacts associated with the 3D seismic surveys in the shallow water prospect were significant and that limited mitigation was possible. The potential impacts included possible direct impacts on the vulnerable dugong population and vulnerable artisanal fishing communities. The degree of uncertainty when assessing these impacts was high and the EIA team recommended that all seismic surveys in the shallow water area (water depths of less than 50 m) be postponed until further research was concluded. The EIA team recommended that a detailed one year research program on the dugong population be established to better understand the extent, distribution and vulnerability of this population. Other studies were also recommended as discussed in the section on Post EIA Monitoring below. The proponent accepted the EIA team's recommendations and the EIA report submitted to the Mozambican environmental authorities for consideration excluded all exploration activities in water depths less than 50 m.

Independent peer review

During the Scoping Phase, the stakeholders requested technical support in terms of reviewing the Draft Environmental Impact Report (EIR). The proponent agreed to provide funding for a peer reviewer and the EIA team assisted the Forum in drafting the TORs for the review. The Forum then ran a tender process to select an independent peer reviewer. The Southern African Institute for Environmental Assessment (SAIEA) was appointed as the reviewer to review the Draft EIA Report and Specialist Studies. The Forum played a key role in ensuring that independent comment was obtained on the EIR by objective, non-partisan technical specialists in the field of EIA, which served to further reinforce the level of confidence

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EIA process followed

in the process and its outcomes among I&APs. Peer review comments were submitted to the Forum prior to it being released to the proponent or the EIA team. The comments of the Peer Review were heeded and included in the Final EIA Report, improving the overall report. In addition, the Peer Review reinforced important EIA recommendations.

Post-EIA monitoring

As mentioned earlier, due to the uncertainties associated with the impacts of seismic surveys in the shallow water area, the EIA team recommended that various detailed baseline and monitoring studies be undertaken during the 3D deep water seismic survey, focusing on:

- Noise attenuation modelling and monitoring
- Fish catch baseline survey and monitoring
- Coral reef baseline survey and monitoring
- Tourism industry baseline survey and monitoring
- Dugong distribution, population dynamics and assessment of the potential impacts of exploration activities on the population.

The above studies included two distinct phases. The first phase involved the collection of more detailed baseline data, while the second phase included monitoring during and after the 3D seismic survey activities. The main purpose for undertaking these studies was to:

- obtain sufficient baseline data against which actual impacts could be measured;
- obtain sufficient monitoring data during and after the exploration activities to define and evaluate actual impacts;
- obtain sufficient baseline and monitoring data to assist with compensation claims should they arise.
- obtain sufficient baseline and monitoring data to assist with future decision making with regards to Sasol's offshore exploration activities in shallow water and sensitive marine environments off the coast of Mozambique.

Although some of the above monitoring studies, such as the noise and coral reefs studies, were inconclusive, the outcome of the dugong and artisanal fisheries studies provided important data to inform the proponent's decision with regards to future exploration activities in the shallow water area. The dugong study reiterated that the Bazaruto Archipelago dugong population probably represents the last viable dugong population within the Western Indian Ocean. It also provided meaningful information as a basis for decision-making with regards to further exploration activities in shallow waters, contributed significantly to scientific knowledge on dugongs, and highlighted the importance of conserving the remaining dugongs population in Bazaruto Bay. The fisheries study confirmed the sensitivity of the area as a key habitat for various fish species and the fact that this habitat supported key artisanal fisheries on which vulnerable coastal communities subsisted.

The outcome of the dugong population study together with that of the fisheries study allowed the proponent to make an informed decision with regards to future exploration activities in the shallow water area. The proponent has postponed

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EIA process followed

all exploration activities in the shallow water area until the conclusion of a Strategic Environmental Assessment, as recommended by the EIA. In addition, the proponent is currently implementing the Bazaurto Conservation Support Programme, the objective of which is to assist the Bazaruto Archipelago National Park in the implementation of its management plan. An integral part of this plan is dugong research and monitoring and the implementation of measures aimed at conserving this population.

Main environmental impacts & issues

Seismic surveys

Impacts of seismic surveys on sensitive features of the environment included the following.

- Seismic noise impacts on marine fauna (especially reef fish, turtles and marine mammals);
- Physical disturbance impacts on sensitive marine habitats (from the Ocean Bottom Cable);
- Impacts of discharges and emissions on the marine environment;
- Seismic noise impacts on fisheries and tourism
- Impacts on shipping, fisheries and tourism due to exclusion zones;
- Visual and noise impacts on tourism
- Cumulative impacts on tourism.

Mitigation of impacts relating to seismic surveys was based on three levels, namely temporal, spatial and operational mitigation. When planning the timing of the seismic operation it was important to avoid periods of high activity of sensitive marine life (e.g. migratory and breeding times) and peak tourism seasons (when diving and recreational fishing are most likely to occur). Spatial mitigation involved setting exclusion or buffer zones and planning the direction of seismic acquisition.

Operational mitigation, aimed at reducing the impact on marine mammals and other animals, included soft starts, having marine mammal observers on the vessels and doing Passive Acoustic Monitoring (PAM) during the 2D survey.

Figure 6: Passive Acoustic Monitoring during the 2 Dimensional seismic survey

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Main environmental impacts & issues

Exploration well drilling and testing

Impacts of high significance from these activities included the physical footprint on the benthic environment due to mooring of the drilling vessel in the Shallow Water Prospect, and the impact on tourism due to the changed sense of place. With regards to mooring, it was recommended that a seabed scan be undertaken prior to mooring the drilling vessel to avoid seagrass beds and reef areas, thus reducing the footprint impact to low significance. Locating the drilling vessel at least 10 km away from the mainland and islands, avoiding peak tourist seasons and carefully planning flight paths of support helicopters to reduce the visual disturbance and impact on sense of place reduced these impacts to medium significance. Impacts of medium significance related to smothering, turbidity and biochemical impacts of drilling fluids and cuttings on the marine environment. These only applied to the Shallow Water Prospect and it was recommended that no drill cuttings or fluids be disposed of in shallow water, reducing this impact to low significance.

Oil spill risks and impacts

While the probability of an oil spill was very low, should a spill occur, the direct impact on the marine environment and resultant indirect impacts on local coastal inhabitants and the tourist industry would be significant. An oil spill modelling study showed that in a worst case scenarios, the impact could reach as far north as Chiloane Island and beyond Ponta da Barra Falsa in the south. Various safety standards were described and precautionary measures identified to reduce the risk of an oil spill, and a detailed Oil Spill Contingency Plan was developed for the project.

Strategic issues

The medium to long term potential impacts on the tourism sector were more complex and more difficult to mitigate. Particularly, the intensity and duration of the medium to long term cumulative impacts as a result of actual and perceived impacts remained uncertain. While the importance of the oil and gas sector to the development of the national economy could not be underestimated, it was recognised that the tourism sector was well established in the area, generating substantial local economic benefits. The perceived incompatibility of the tourism sector with the oil and gas sector perpetuated a negative attitude towards tourism and investment in tourist infrastructure. To counter these perceptions and in the interest of the sustainable development of the area, the EIR recommended that the Government undertake a Strategic Environmental Assessment to assess the costs and benefit of encouraging tourism and oil and gas development as well as the other sectors in the area.

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Decision-making process

The proponent's team interacted closely with the EIA team in every phase of the EIA process. This allowed the proponent to fully understand all issues associated with a lack of information, the sensitivity of the environment and the expectation of the stakeholders, allowing for informed decision making with regards to extensions of budgets and time frames for the completion of the EIA. It also made the decisions with regards to the no-go option for the shallow water area far easier.

Ongoing interaction between the EIA team and the Mozambican environmental authorities (MICOA) was facilitated throughout the EIA process. This allowed for swift decision making by MICOA. The Draft Scoping Report was accepted by MICOA without any comment. Due to the extensive stakeholder engagement process undertaken during the EIA, MICOA deemed that it was not necessary to hold further public hearings once the EIA report has been submitted for consideration. The EIA was approved by MICOA in October 2006 and the Environmental License was issued in January 2007. No appeals against the decision were submitted.

Implementation of the EMP & compliance auditing

Mitigation measures were specified in Environmental Management Plans for the seismic surveys and for exploration well drilling and testing. The EMPs consisted of a set of management and monitoring measures to be undertaken during implementation. Sasol was ultimately responsible for the implementation of the EMP and ensured compliance through diligent contractor selection and direct contractor management. Sasol also conducted internal reviews of EMP implementation during the 3D seismic survey and drilling activities. In addition, Mozambique's environmental authorities, in association with the National Petroleum Institute and the Labour Ministry, also conducted audits of the 3D seismic survey and drilling activities. The findings of the audits were used in updating the EMPs and operating procedures to ensure improved performance.

Based on the requirements of the EMPs, Sasol appointed ERM and Consultec to coordinate and implement the following additional baseline and monitoring studies.

- Noise attenuation modelling and monitoring.
- Fish catch baseline survey and monitoring.
- Coral reef baseline survey and monitoring.
- Tourism industry baseline survey and monitoring.
- Dugong distribution, population dynamics and assessment of the potential impacts of exploration activities on the population
- Turtle monitoring.

Stakeholder engagement, including the Stakeholder Forum, continued after the EIA process ended as status of the project and the aims and objectives of the monitoring studies needed to be communicated to all stakeholders. The Stakeholder Forum was continued as it presented an effective medium for communicating with representatives from various sectors. The Stakeholder Forum meetings and public meetings held prior to and during project implementation created an open communication channel with stakeholders to discuss issues related with project

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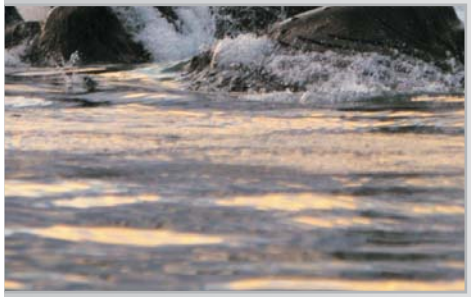

Implementation of the EMP & compliance auditing

implementation and the additional studies. Issues discussed during meetings contributed to the clarification of uncertainties regarding the project as well as for the improvement of existing programmes. In addition, a separate but linked Operational Communications Plan was developed to ensure that communication with effected stakeholders during the seismic surveys was efficient and effective. Throughout the seismic survey and drilling activities, stakeholders were kept informed of the schedule of activities and how this may influence their activities on a daily basis. This was done by a dedicated communications team, including a Public Relations Officer and Fisheries Liaison Officers. A Compensation Plan was also developed to ensure that stakeholders affected by the project were compensated for damages and losses. A Compensation Team went into the field ahead of all project activities to ensure that stakeholders were briefed on the compensation procedures. As project activities mostly occurred in the deep waters away from the mainland and islands, very few claims were lodged, mostly associated with the enforcement of the exclusion zones, and all were investigated and compensation paid out.

Main elements of excellence in this EIA

Key elements of this EIA that stand out include the adaptability during the Scoping Phase, the in-depth stakeholder engagement process that was undertaken, including the Stakeholder Forum, the no-go option that was recommended by the EIA, the peer review process that was implemented and the post EIA monitoring.

A core element that contributed to the success of the EIA was the willingness of the proponent and the ability of the EIA team to adapt the EIA process as the sensitivity of the affected environment became better understood and as stakeholder expectations evolved. While a comprehensive stakeholder engagement plan was initially developed, it was adapted to address stakeholder expectations throughout the process. The engagement process was crucial for ensuring the proponent's 'social license to operate'. It allowed for a gradual increase in trust in the outcomes, and contributed to the overall quality of the process.

Two aspects of the stakeholder engagement process were firsts in the Mozambican context: the establishment of the Stakeholders Forum as a vehicle for open and continuous dialogue, and the Independent Peer Review within a socio-economic context of competing development pressures. These were bold steps in the environmental decision making framework in Mozambique.

Stakeholder Forum members recognized the importance of their own contribution to the EIA process in the improvement of mitigation measures as well as in disseminating information to the broader public. Following a review of the Forum, the members indicated that they wished to continue to convene to maintain and build up the communication channels which had been established during the EIA phase.

Another core element was the willingness of the proponent to accept the recommendation to delay exploration activities in the shallow water area until the completion of the SEA. This decision was supplemented by the commitment to fund a conservation programme in and around the Bazaruto Archipelago, a focus of which is ensuring dugong conservation.

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Lessons learnt

There are a number of aspects that, if they were approached differently, would have improved the EIA process.

In the ambit of the Forum, the EIA project team could have employed more creative ways of communicating highly technical information to the different stakeholder groups. The major form of communication during public and Forum meetings was via Power Point presentations. This was not always appropriate. While poster displays were also used, the EIA team could have placed more emphasis on simplifying the information and using alternative techniques such as audio-visual clips of exploration activities and other project information.

The complexity of the project could have been simplified by splitting the project into the seismic and drilling components and undertaking separate EIAs rather than combining them into one. This would have simplified the process and would have allowed the EIA project team to focus on the specific issues at hand.

The EIA process could have benefited from more senior participation from relevant government agencies. Some of the issues raised by stakeholders were more strategic in nature and could not be addressed by the proponent. Representation from relevant government departments could have clarified the government position on some of these issues promptly while at the same time allowing for more accountability in terms of government's understanding of the stakeholders' concerns.

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