

Determining the potential impact of unconventional oil and gas mining

A completed Water Research Commission (WRC) study has developed an interactive vulnerability map and monitoring framework to assess the potential environmental impact of unconventional oil and gas extraction by means of hydraulic fracturing.

Background

This WRC study was proposed in light of the applications that were made by various companies for exploration permits for the extraction of shale gas and coalbed methane. The study focused specifically on understanding the unconventional oil and gas extraction process, identifying possible impacts associated with unconventional oil and gas extraction and hydraulic fracturing (also known as fracking), as well as identifying vulnerable areas that need protection in terms of unconventional gas extraction.

Hydraulic fracturing has raised concerns worldwide. The US Environmental Protection Agency, for example, is performing an environmental impact study on hydraulic fracturing at Federal level following reports of possible water contamination resulting from unconventional gas operations.



An active hydraulic fracturing site in the US.

It is also noted that significant volumes of water are required to extract shale gas and this could put severe pressure on water supplies in areas of drilling. Regarding the harmful nature of the chemicals used in fracking, it has been noted that there could be some issues related to the mobilisation of chemicals within the shale to surface water and groundwater and that mitigation of the risk to aquifers relies on companies undertaking the proper measures to protect the environment from pollution.

Apart from the specific concerns related to hydraulic fracturing, the unconventional oil and gas extraction process (including seismic surveys and infrastructure development in the form of roads and pipelines) may also have significant impacts on the biophysical and socio-economic spheres.

The following concerns have been highlighted with regard to the exploration for unconventional gas in the Karoo:

- There is insufficient information on the potential health risks to the public as a result of water contamination;
- There is an unacceptable risk of losing globally unique biodiversity, jeopardising ecological integrity and causing loss of irreplaceable resources for which remedy is not feasible;
- There is an unacceptable risk of having an irreversible impact on the sense of place of the Karoo and on the lives, health and livelihoods of its communities;
- There is a substantial risk of inequitable distribution of impacts arising from the proposed activity and of vulnerable rural people having to bear the negative impacts; and
- In the light of significant uncertainties there is a need to take a risk-averse and cautious approach.

Results of the WRC study

The WRC study investigated unconventional oil and gas extraction and hydraulic fracturing by performing a background review in order to understand the unconventional oil and gas exploration and extraction process and its possible related impacts. In addition, the study developed an interactive vulnerability map to aid in decision-making as well as develop a monitoring framework that provides a framework for the monitoring of specific entities, including surface water, groundwater, vegetation, seismicity and socio-economics.

The final report highlights the challenges that South Africa will have to address when pursuing unconventional oil and gas, such as managing the related impacts at different scales (regional scale cumulative impacts that may cross provincial and water management boundaries versus local-scale impacts such as the effect of local-scale contamination on the riverine rabbit), addressing the lack of data in certain disciplines (for example, the uncertainties related to deep groundwater systems, artesian aquifer systems and deep geology) and addressing the low levels of inter-institutional cooperation.

The report also describes how the possible impacts on the biophysical and socio-economic environments may interlink. For example, while oil and gas exploration and extraction may drive socio-economic development in certain areas, worker migration may impact negatively on municipal service levels, while impacts on the environment (water contamination, seismicity) may impact on community health and safety.

The complex inter-linkage of impacts necessitates that inter- and intra-institutional cooperation and communication be optimised in order to effectively manage and minimise possible impacts related to unconventional oil and gas extraction.

The governance of oil and gas extractions should be handled as a whole and linkages between the biophysical and socio-economic environments should be researched, understood and managed in an integrated way. The National Environmental Management Act (107 of 1998) (NEMA) principles acknowledge the interdependence of socio-economic and biophysical systems, and one of the key principles of the NEMA requires that all developments be socially, economically and environmentally sustainable.

Sustainable socio-economic development can only be achieved if the considerations of development, as

underpinned by the right to socio-economic development, are weighed against environmental considerations, as underpinned by the right to environmental protection.

In South Africa, where water demand will exceed water supply in the near future, unsustainable use of water resources will result in increasingly limited water resources for future health and well-being as well as for sustained socio-economic development. Society in general, and specifically the residents in the Karoo where access to water is already limited, needs to be assured of the sustainable use of the water resources for health and well-being by understand and, where possible, avoiding the negative social impacts resulting from unconventional gas extraction by means of hydraulic fracturing.

The WRC report is not prescriptive and should be used as a guidance document for decision-making. It attempts to address most of the important potential issues regarding unconventional oil and gas extraction in South Africa.

Vulnerability map

The vulnerability map aims to assist decision-makers and other practitioners by providing information on the vulnerability to unconventional gas extraction of the specified mapping themes on a regional scale. The map is intended as a reconnaissance tool to inform decision-makers on areas where additional field work and assessments may be required. It may also be of use during environmental impact assessments and the determination of licensing conditions.

The map is interactive and users can zoom in or out and can activate or deactivate base maps and overlays and click on activated layers to obtain detailed information associated with those layers.

Monitoring framework

It is extremely important for South Africa to perform baseline monitoring before exploration starts to make sure that we have the reference conditions in order to identify what impact oil and gas extraction activities have on the biophysical and socio-economic environments. Without such a baseline determining impacts would not be possible.

It is also important that monitoring takes place during the exploration and extraction processes as well as post extraction, since some of the impacts may only be observed long after wells in a certain area have been decommissioned.

The monitoring framework can be used as a guideline for planning monitoring activities, during the various phases of unconventional gas extraction. The objective of the framework is to identify the important entities to be monitored during the various phases and discuss means of monitoring for selected entities (surface water, groundwater, seismicity, vegetation and socio-economics).

Although the list of entities discussed in this framework is not exhaustive, it could assist government in planning for the monitoring of the entities of most concern. The framework discusses issues such as why monitoring of certain aspects is required, where monitoring must be performed (i.e. site specific or regional), when it must be performed, how it must be performed, and who the relevant parties are that should do this monitoring.

The framework also addresses various legal and governance considerations related to such monitoring, such as the role of international law in South Africa, the interaction of differences pieces of legislation related to the monitoring of selected media and areas of concern.

Recommendations

The interactive vulnerability map and monitoring framework can be used as guidance by authorities to develop regulations and effectively regulate unconventional oil and gas mining in South Africa. Since technology advances are progressing quickly in this sector, it is recommended that authorities and practitioners update their knowledge regularly while addressing uncertainties or knowledge gaps.

Various uncertainties and knowledge gaps currently exist. For example, groundwater use is one of the aspects over which there is uncertainty (most datasets are not entirely accurate) and the human dependence on groundwater as indicated in the vulnerability map needs to be updated with more accurate and finer resolution data.

In addition to the subterranean groundwater control areas, other sole source aquifers (which may not be known at this stage) and possible new aquifers also need to be identified and included in the vulnerability map.

These activities are extremely important if the Department of Water and Sanitation is to protect groundwater in water scarce areas for human use. South Africa's knowledge on deep geology is further limited, and for vegetation, various areas still need to be mapped.

In terms of unconventional oil and gas extraction, the

deposits that may have economically extractable oil and gas is still unknown, as are the possible stimulation techniques that may be required for extracting these resources. With regard to the numerous uncertainties related to proposed oil and gas extraction activities and the knowledge gaps in biophysical systems, possible negative impacts must be anticipated and prevented where possible and a risk averse and cautious approach must be followed that takes into account the limits of our current knowledge.

In terms of monitoring it is recommended that baseline surveys be performed as a matter of urgency.

The regional scale of possible impacts makes integrated, systematic, standardised monitoring across regions very important, and necessitates integration between local and provincial government, alignment and cooperative governance between different government departments, alignment between different pieces of legislation, among others, to make monitoring efforts successful.

It is vital for industry and government to recognise the complexity of the challenges posed by these potential impacts. However, the impacts can be minimised where an effective regulatory system and best monitoring practice are in place, and can be remediated where they do occur.

If the oil and gas industry is to earn and retain the social licence to operate, it is a matter of urgency to have a transparent, adaptive and effective regulatory system in place that is implemented and backed by best practice monitoring, in addition to credible and high-quality baseline surveys.

A major coordinated programme of research to address the various uncertainties and knowledge gaps should be initiated at an early stage to ensure that South Africa is ready for unconventional oil and gas exploration and extraction.

Further reading:

For a copy of the report, *Development of an interactive vulnerability map and monitoring framework to assess the potential environmental impact of unconventional oil and gas extraction by means of hydraulic fracturing* (Report No. 2149/1/14) contact Publications at Tel: (012) 330-0340, Email: orders@wrc.org.za or Visit: www.wrc.org.za to download a free copy.