STRATEGIC ENVIRONMENTAL ASSESSMENT OF A REGIONAL OIL & GAS PROJECT IN ARGENTINA

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ABSTRACT

The "Vaca Muerta" reservoir (Neuquén, Argentina), covers 30.000 Km^2 and is the second largest Non-Conventional gas reservoir in the world. Its development will need to drill over 1500 wells during the next 25 years, generating over 50.000 new jobs, and duplicating the regional gross product. A Strategic Environmental Assessment of the regional project results in a synthesis of environmental impact and mitigation measures. The private sector (industry) needs to establish certification processes in order to minimize potential conflicts and generate an environmental management system to ensure continuous improvement. A strict application of environmental measures, from the planning to the production phase, applying "Good practices" and independent certification process, can minimize the potential negative consequences on the regional environment. To strengthen regional and national governmental regulation and control capacity, it is suggested to establish inter-institutional cooperation agreements with national research and development institutions, to help generating information for environmental monitoring programs, developing "Good Practice Guides", and doing external audits and inspection in the field, for a continuous improvement process. The environmental management of the regional project is a challenge both for industry and for the Government, it is an historic opportunity to transform the exploitation of NCH resources into a sustainable regional development plan.

INTRODUCTION

The energy situation in Argentina is at the end of a cycle based on the use of hydrocarbon resources (oil and gas) from conventional reservoirs and the possibility of starting a new stage based on hydrocarbon resources from unconventional reservoirs (UR) (Riavitz & Bronstein, 2015). This paradigmatic change uses a more complex technology, with more important initial investments and a different production and business scheme.

The objective of this work is to conduct a strategic environmental assessment of the exploitation of unconventional hydrocarbon resources (HCNC), involving the analysis of environmental impacts and risks (on the natural and social environment), in a regional, sectorial and long-term context, considering the current institutional framework (Sarandón, 2015).

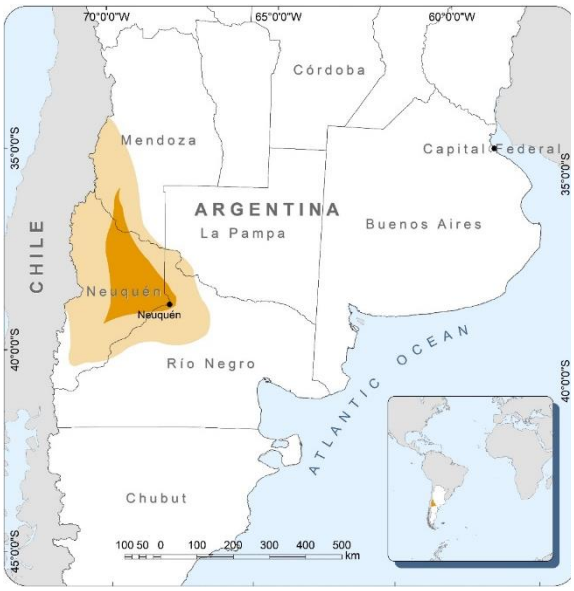
STUDY AREA AND METHODOLOGY

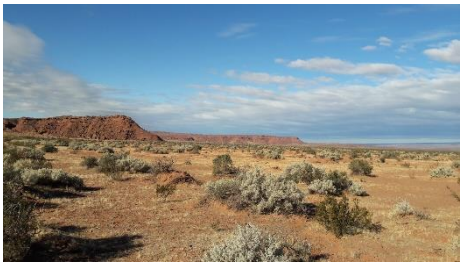
The "Vaca Muerta" reservoir (Neuquén, Argentina; Fig. 1), covers 30.000 Km2 and is the second largest Non-Conventional gas reservoir in the world (Di Sbroiavacca, 2013; Riavitz & Bronstein, 2015). Its development will need to drill over 1500 wells during the next 25 years, generating over 50.000 new jobs, and duplicating the regional gross product. The area presents unconventional oil and gas resources, around 27 billion barrels and 802 trillion cubic feet respectively. These resources represent 8% and 11% of this type in the world.

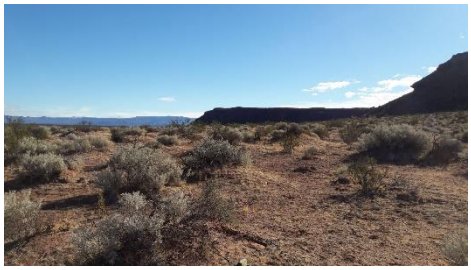
The research were based on the review of literature, field visits (Photo 1 & 2), contact with local people and authorities, and data processing. The review included generic and specialized papers on unconventional reservoir (IAPG, 2012; RS & RAE; 2012; López Anadón et al, 2013; ANI, 2013),

on SEA (Partidario, 2010; 2012), and environmental issues related on UR (Entrekin et al, 2011; King, 2012; Taillant et al, 2013; USEPA, 2011; 2012; 2014), and local paper on local and regional ecological and social systems.

Figure 1: "Vaca Muerta" reservoir, Neuquén, R. Argentina. Photo 1 & 2: Vegetation cover in the study area of Neuquén Basin (Calvetty Ramos, 2017).







RESULTS

For each stage of project development (individual well), environmental issues and measures was developed (Table 1). In order to minimize environmental impacts and risks, companies should apply good practices in each phase of an HNC project.

Regional and cumulative environmental impacts and risks includes environmental pollution and health risk, affectation of natural resources, impact on the welfare of the population and regional and institutional issues (Table 2 & 3). The application of environmental measures to regional, indirect and cumulative impacts and risks requires the involvement of different actors, including companies, government and academy.

The results of the SEA of the exploration and exploitation of "Vaca Muerta" Reservoir, suggest that, there is a need for companies to incorporate environmental and social aspects into the development of the project:

1. Complying with current regulations (EIA).
2. Implementing environmental management strategies:
   - Assigning responsibilities within the company.
   - Implementing Environmental Management Plans (EIA).
   - Maintaining environmental quality standards (ISO 14001).
   - Prioritize environmental and social aspects.
   - Apply best practices (international).
3. Obtaining the local social license, maintaining good relations with "neighbors".
4. Involving other key actors to lead the process of integral regional development.

Table 1: Environmental issues and measures in each stage of project development.

Stage	Environmental Issue	Environmental measures
Preparation	Environmental and social studies. Regional environmental baseline studies. Application for permits and certificates. Information and dissemination.	Plan environmental and social aspects. Environmental standards. Identify sensitive areas, natural elements and vulnerable human groups. Contact with local authorities, settlers and opinion groups.
Exploration	Alteration of the ecological (natural), productive (land uses) and social (customs, traditions) environment.	Minimize alteration on ecosystem and current land uses. Control noise, treat effluents and manage solid waste.
Infrastructure	Aspects associated with the adequacy (planning, construction and operation) of the regional infrastructure (routes, internal roads, aqueducts, electric power, treatment plants).	Environmental care during construction and operation of service infrastructure. Permissions and information to owners and users. Social feasibility analysis.
Location	Permanent modification of the property. Change of natural conditions, and limitation of use and occupation.	Minimize land occupation. Optimize drilling sites. Control emissions, effluents and waste. Territorial planning of "cluster" location. Environmental restoration.
Drilling	Generation of solid waste ("cuttings"), semisolids (drilling mud) and liquid effluents. Environmental accidents.	Management and disposal of special solid waste ("cuttings"). Management and treatment of liquid effluents. Prevention and response to environmental contingencies.
Finishing	Generation of waste (solids, liquids). Correct completion and supervision of the well. Environmental incidents	Inspect and certify termination. Cleaning and integral waste management. Prevention and response to environmental contingencies.
Fracking	Consumption, transport, storage and handling of water, sand and additives (chemical substances). Management, treatment and final disposal of "flowback".	Precautionary management of substances. Integral management of return waters. Environmental monitoring and contingency.
Production	Waste generation (solids, liquids) during maintenance. Prevention and management of contingencies (incidents, accidents).	Integral waste management. Monitoring and control of facilities. Environmental monitoring at regional level. Restoration of lease areas. Environmental contingency plans.
Abandonment	Solid waste generation. Accidents (spills). Generation of environmental liabilities.	Evaluation of environmental liabilities. Ecological restoration and monitoring.

CONCLUSIONS AND PROPOSAL

Some recommendations for the integral feasibility of the HNC project are:

a) Prepare an Environmental Baseline on a regional scale: with identification and mapping of sensitive or vulnerable areas (environmental, hydrogeological risk, etc.).

b) Implement an institutional strengthening at the provincial level to adapt the environmental management capacity to the project (planning, evaluation, regulation, control, inspection, etc.).

c) Develop and implement new environmental management tools:

- Good practices guides for the exploration and exploitation of the HNC;
- Independent certification processes for drilling and completion of wells;
- Registration of suitable technologies for drilling, chemical products use as additives in hydraulic fracturing; accidents, etc.
- Environmental Risk Assessment;

- Regional environmental monitoring of key indicators (air, surface and groundwater, terrestrial and aquatic ecosystems, land use, health, etc.).

d) Establish inter-institutional agreements among Provincial Government - Regional Research Centers and National Universities - Companies - National Government, for Scientific and technological advice, environmental management, and regional development.

e) Develop a communication and participation strategy; and

f) Develop a compensation strategy: consolidate protected natural areas for the ecological restoration of intervened areas.

Table 2: Pollution and health, and affectation to natural resources

IMPACT RISK	ENVIRONMENTAL MEASURES	RESPONSABLE
Water contamination	Application of best available practices. Treat return waters avoiding its superficial tipping (flowback), encouraging reuse. Implement environmental contingency program. Supervise perforation and cementing. Independent certification of completion.	Provincial government and Companies
Air Contamination	Demand application of best available practices. Certify the completion of the wells (pressurization tests) before starting the exploitation. Permanent monitoring of potential methane leaks.	
Solid Waste Contamination	Management of drilling waste and treatment of hazardous waste. Consolidate a regional waste treatment center. Supervision and external certification of drilling technologies. Demand application of best available practices.	Federal and Provincial government and Companies
Contingencies associated with local conditions	Mapping and zoning of geological, hydrogeological and environmental risk conditions. Specific practices for vulnerable conditions. Regional monitoring of seismicity. Application of best available practices.	
Conflicts over availability and use of water	Evaluate the availability of water & ecological flow in relation to the source. Measurement and monitoring of flows and quality. Promotion of water recovery and recycling.	Provincial
Alteration of local ecosystem	Minimize alteration of the local ecosystem. Identify and map ecologically sensitive areas. Ecological restoration of sites. Establish and consolidate protected natural areas to compensate for regional biodiversity alteration and promote restoration of ecosystem services.	Provincial Companies
Alteration of the land use and occupation of the territory	Land planning near the development area, identifying vulnerable sectors, zoning for various uses, develop infrastructures of public services (water, sewage, urban solid waste), and educational and health services. Land planning of urban centers.	Municipal Provincial

General conclusion:

In order to minimize the potential negative consequences on regional natural resources, the welfare and the quality of life of the population, it is required:

I) A careful planning and implementation of HNC exploration and exploitation activities, following strict execution standards in the framework of "Best Practices".

II) To establish independent certification processes for the exploitation of HNC resources, based on excellence and transparency, in order to minimize potential conflicts and generate an environmental management system that ensures continuous improvement.

III) To strengthen the regulatory and control capacity of the enforcement authority, establishing agreements with regional research and development centers, companies and other actors.

The exploitation of the HNC constitutes a challenge both for businessmen and for the provincial and national government. It is an historical opportunity, if giving priority to environmental and social issues, for the development of the HNC resource exploitation project into a comprehensive regional development project.
Why companies should get involved? No one better than the industry to ensure the long-term continuity of the activity. For that, it is necessary to have a social license, and face a paradigm shift: Lead the process of sustainable regional development.

Table 3: Welfare affectation and regional and institutional issues

IMPACT RISK	MEDIDAS AMBIENTALES	RESPONSABLE
Modification of the social context	Development plans at local level. Combined with occupation & transport strategies. Plan and organize the process of immigration and urban expansion.	Provincial Municipal Companies
Traffic congestion	Implement transport controls at specific points. Establish routes, schedules and circulation priorities.	
Deterioration of road infrastructure	Improve road infrastructure (asphalt, crossings, roundabouts, signage)	Provincial Municipal
Demand for solid waste management	Establish a regional solid waste system (urban and special). Analyze the need for new sanitary landfill and special treatment center. Promote strategies of reuse, recovery, recycling (3R).	Companies Municipals
Investment demand for local development	Regional plan of infrastructure and social equipment, productive investments and training. Agreements with local governments. Schools and local training workshops.	Federal Provincial Companies
Alteration of economic relations in productive systems	Provide training instances and retention schemes for skilled labor in jobs in local production systems (agricultural, fruit and vegetable production, construction).	Provincial
Deterioration of cultural, historical, paleontological heritage.	Evaluation of heritage. Preventive surveys. Organize responses to findings. Inform companies of responsibilities and procedures. Organize, train and equip a technical team of specialists of universities.	Federal Provincial Companies
Demand for environmental controls	Institutional strengthening (provincial). Technical assistance from research centers and universities. Management plans at regional level (monitoring). Regional Environmental Baseline Strategy.	Provincial Federal
Technological Development	Conform Technological Development Center (Government, Companies, University), to evaluate and certify new technologies.	Federal Provincial Companies
Conflicts of accessibility to disputed areas	Mapping of areas in conflict. Territorial organization and integral agreement between the provincial government and representatives of aboriginal communities.	Provincial
Consolidation of the use of fossil fuels in the energy matrix	Benefits of the development of the HNC should be used to subsidize the research and development of renewable energies (wind, solar). Develop a long-term national energy plan, increasing the use of renewable energies. Promote the development of local technologies.	Federal Provincial

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