Original Research Article

Chad-Cameroon oil pipeline: the socioeconomic and environmental issues for local residents

Abstract

The objective of this study is to analyze the socio-economic and environmental issues of the Chad-Cameroon oil pipeline. In other words, it is a question of assessing the effects of the pipeline on both the living conditions of the population and the biodiversity of the Atlantic Coastal Zone of Cameroon. To do this, the Contingent Evaluation Method (CEM) is used to determine the willingness to pay (WTP) of the local populations. The collection of data in the study field makes it possible to obtain the opinions of local residents. This collection highlights the preferences expressed by 300 local residents. Most of the effects of pipeline operation are negative for local residents and for the environment in which they live. For instance, most of them have lose their sources of income, resulting from activities related to agriculture, hunting, fishing, and picking. This is caused by the aggression suffered by the natural space. On the other hand, the pipeline seems to have a positive effect on the operating company, which has made huge profits. The results obtained lead us to consider a reflection on effective measures that allow all stakeholders to take part in decision-making that integrate sustainable development Goals SDG-7.

Keywords*:* oil, pipeline, CVM, WTR, local resident, Cameroon.

1. Introduction

Comment [JF1]: This section is fine, but I suggest informing the objective after the problem question. Specifically because the objective is formulated based on the problem, not problem based on the objective.

The Chad-Cameroon pipeline is one of the largest investment projects in sub-Saharan Africa (Hoinathy, 2013), implemented by the Exxon-Petronas-Chevron Consortium. Also, the

US$3.7 billion pipeline project includes the operation of 300 wells in three oil fields in Chad. It is financed by the governments of Chad and Cameroon, the international consortium, and the World Bank (WB). This pipeline is intended to promote the development of Cameroon and Chad (Point, 2005). The implementation of this oil project, mainly financed by the international consortium led by EXXON, has led to three complimentary technical assistance projects: Cameroon petroleum environment capacity enhancement project, Chad management of the petroleum economy project, and Chad petroleum sector management capacity building project. The World Bank give the conditions for the operation of the pipeline. In addition, it supervises all pipeline activities and the non-governmental organizations (NGOs) involved in the pipeline's construction. The international consortium of oil companies (COTCO Cameroon Oil Transportation Company) is proposing an environmental improvement program in partnership with the Foundation for the Environment and Development of Cameroon (FEDEC) and other environmental NGOs. In this context, the Government plays the role of a "transmission belt" connecting the local population and the oil companies of platforms on various activities, they ensure each side´s involvement and sharing of information.

The transportation of oil via the Chad-Cameroon pipeline extends over 1070 km, 891 km of which pass through 242 villages spread over five regions in Cameroon. The oil is transported via the pipeline to Kribi (a seaside resort), where a floating terminal is installed 11 km from the coast. The pipeline is 76 cm in diameter and is buried 100 cm deep in the ground, and 150 cm under roads, rivers and railways (Roitman, 2004). The 300 identified wells produce nearly 225,000 barrels per day, and after 25 years, production will be 924 billion barrels (1 barrel = 160 liters) according to the operating company COTCO.

Regarding its complementary projects and its players, it seems relevant to us to analyse the stakes of the Chad-Cameroon pipeline. The aim is to understand the impact of this vast project on government policies in terms of good governance. However, it will also be a question of studying the impact of this project on the social, economic and environmental levels and the implementation of the World Bank's major Millennium Development Goals, which aim to reduce poverty and protect the environment by 2015. The analysis is based on the standards established by the Environmental Management Programme (FOCARFE, 2002) to better expose the possible positive and negative effects of the Chad-Cameroon pipeline (Broche et a, 2005).

Examining the impacts of the Chad-Cameroon pipeline project is vital because of the many painful experiences around the world. During these tragedies, the oil slick released covers a

large area and extends vast distance off the coast. Millions of migratory and aquatic birds, marine mammals, otters, and several species of whales have been threatened by this oil spills. The oil exploitations, although generating a considerable amount of capital, require well-developed impact studies beforehand. This justifies our need for an analysis of the benefits and shortcomings of the Chad-Cameroon pipeline. This study could also provide more information on the expectations of local populations or civil society, the Chadian and Cameroonian governments and the operating company.

Moreover, the "Peoples' Court of Cameroon" has already condemned the consortium and its subcontractors for the lack of respect for economic and social rights and pre-established standards in terms of environmental protection rights. The consortium has also indexed its way of instituting not only abstract methods (Moratorium civil society, 2005), but also its insufficient actions to mitigate the damage generated by the pipeline route. Hence the following question: What are the socio-economic and environmental stakes of the Chad-Cameroon pipeline project according to the local populations

The importance of this work is in two section: the first section aims to revisit the theories relating to the socio-economic and environmental impacts of oil exploitation and to better understand the use of evaluation tools in environmental economics. In the second section, this study focuses on an intervention in the field of environmental economics.

This study aims first to have an effective and transparent intervention to help government authorities make decisions based on results. Thus, it could enable the empowerment of agencies to monitor activities, through more effective evaluation of externalities and their rapid internalization. It can also help to consider the real needs of the affected populations, through the field survey and the RAC calculation carried out as part of this work. According to Laffont and Tirole (1993), the involvement of households in the direct management of environmental affairs favorably modify existing environmental policies (economic growth, population explosion, etc.).

Below is a literature review on the socio-economic and environmental impacts of industrial projects. We will then analyze the statistical processing of our field data and the RAC of the populations to compensate for the possible loss of well-being (environmental values) resulting from the Chad-Cameroon pipeline. These results will be compared with the literature review and allow to make political recommendations.

2. Theoretical and empirical linking of the assessment of socio-economic and environmental impacts.

Climate policy is in great difficulty and in a period of a paradigm shift (Damian, 2014). Bertrand and Amalric in 2017 argued that the development of these local climate policies should be based on the use and scope of an international consultation mechanism. The negotiations were a fiasco. Today, we know that if we stick to the proposed reduction objectives for the decades to come not to exceed 2°c of warming or 50-80% fewer emissions by 2050 the objectives would still not be met.

It is undeniable that the precautionary principle (Henry, 2002) is taken into account in the implementation of the Sustainable Development process (Perrings, 1991). Hence the meteoric rise of environmental economics theories from the 1960s to limit the abusive use of natural resources.

In recent decades, the international scientific community has become interested in the environmental problems resulting from the irrationality of man's use of natural resources (Barde, 1992). Pollution of the air, water, soil, fauna and flora are all polluted by man's harmful activities. The multiple pressures on the environment cause it to lose its economic and, above all, vital functions (Munasinghe and Meier, 1993). This explains the difficulty of regenerating the environment, hence the problem of the « Club of Rome ».

In the 1970s, thanks to NGOs and international institutions such as the World Bank (WB), the World Wide Fund for Nature (WWF), the World Commission for Environment and Development (WCED) and the World Resources Institutes (WRI), the evolution of the economy became apparent following the many ecological disasters. The discovery of sustainable development in 1987 under the leadership of Norwegian Prime Minister Gro Harlem Brundtland laid the foundations for environmentally friendly development with an emphasis on the protection and preservation of the ecosystem. According to Pezzey (1992), this efficient management makes it possible to preserve the stock of natural capital, particularly in oil exploitation.

Baumol and Oates (1998) suggest internalizing these effects through their characteristics, such as, speaking of transferable externalities. Other studies take a different approach to this notion, such as those of Ragni (1997) who speak of pecuniary externalities, while Cornes and Sandler (1995) speak rather of distributional externalities. Furthermore, Davis and Kamien in 1972, show that externalities constitute obstacles to the efficient functioning of market mechanisms. This requires that the generator of the externalities suffers the damage and bears the costs of repair: hence the Polluter Pays Principle (PPP).

The PPP, an inking point, requires that any project initiator who generates externalities internalizes the costs of making the polluter bear the difference between social and private costs. This is a principle of economic efficiency which very quickly found limits in its application due to the negligence of project promoters. Thus, it was necessary to define a participatory evaluation method that could integrate all the project stakeholders. The limitations of this evaluation method are reflected in the absence of a market for priceless environmental goods.

Subsequently, environmental economics broadened to include both cross-border and insecurity aspects (Stockholm conference, 1972) in order to combat international pollution and ensure the best possible protection of natural areas, particularly those of the common heritage of humanity. The study proposed by the World Bank for the approximate determination of the long-term qualitative and quantitative effects is taken into account by the research firms. For example, in relation to the Chadian export project, the Dames & Moore firm carried out a "cost and benefit" analysis and the results of this analysis were as follows:

- The reduction of indirect compensation costs
- Exclusion of consortium costs in the analysis.

In addition, we have secondary data from the literature review (Boidin and Zuindeau, 2006). Based on this research and the literature review on the socio-economic impacts of industrial projects, we can, allocate the fruits of this project and define measures that will make it possible to rationalize industrialization projects. We can also propose actions or means to promote the improvement of the consultation framework that will enable the parties (civil society, government, COTCO) to better ensure social closure (taking into account the demands of local residents), exchange of information, difficulties and also adapt their interventions within the project framework. This framework, characterized by a lack of responsibility on the part of the various stakeholders, handicaps and considerably slows down the implementation of many files. It also contributes to maintaining suspicions and grievances between the actors (Tulipe, 2004).

3. Methodology:

The assessment of socio-economic and environmental impacts has grown significantly due to its importance in the development of structuring projects over the last two decades (Cropper and Oates, 1992; Knestsh, 2007). According to OECD manuals (1989) and World Bank reports (2005), an assessment of externalities is currently required.

3.1. The presentation of the survey units and the econometric model.

Comment [JF2]: It was not clear the analysis of your data. How did you analyze your data? What were the types of tests performed? Science and the reader need to be clear about what resulted in their research.

3.1.1. Sampling

The survey covered 130 households in the districts of Ngoumou and Kribi, of which 50 in Ngoumou and 80 in Kribi are representative areas in terms of social, economic and environmental impacts. The size of our sample was dependent on budgetary constraints and the purpose of the study. We drew five households per village and in each village the first household was chosen at random, and the others were selected with sampling step 20.

3.1.2. Questionnaire

Our survey was carried out by administering a 7-page questionnaire to heads of household. This questionnaire was divided into three main parts: identification of the head of household, socio-economic assessment and environmental assessment.

3.1.3. Fieldwork and data Conclusion

The method used here was that of itineraries with one interviewer per village. The data collection lasted seven days. The questionnaires were entered using a data entry mask designed on the "CSPRO 2.6" software. The resulting database was transferred to SPSS11.0, allowing us to perform the consolidation and analysis of the data, and the estimates were made on STATA after exporting the data.

Assessing the impacts of the Chad-Cameroon pipeline project requires an analytical method that takes into account not only the preferences of communities that have suffered the external effects of the pipeline, but also the level of involvement of other actors in the project. Cost-Benefit Analysis (CBA) is used to assess the effects. The benefits generated by the project make it possible to reach a social optimum through a better harmonized compensation plan (Ballet, 2005). CBA thus highlights the consent to be received (CTR) of the neighboring populations. Furthermore, based on declared preferences, the contingent valuation method (CVM), is the participatory method indicated to verify the second hypothesis of this work. The choice of the CVM results from the fact that there is no market for environmental assets because environmental goods have no price. In this article, we rely on two working hypotheses that guide our theoretical and methodological choices:

- The project has effects on the environment and local populations. This will involve a statistical and descriptive analysis which consists of presenting the different impacts and the level of their actions in the development process.
- The RAC is an effective way to find compensations for the harm suffered by the populations.

The modelling will be that of the dependent qualitative variables Yi, in this case the logistic

model, Yi is the level of satisfaction with the well-being or quality of the environment.

The vector Xi includes the following variables: District of residence (Q01), sex (Se), age (Ae), monthly income (RM), health S (Q221a, Q227), education level (ninst), marital status (sm), number of persons in employment (NPe), price change (price effect), diversification of activities (Q249a), facilitated travel (Q248), employment (Q242a, Q243f), water management (Q311c), management of cultural and sacred sites (Q324a), land restoration (Q333c), agriculture (Q211a, Q212c).

And the coefficients βi will determine from which we will have the Odds Ratios (OR).
We have:
Pi the probability that the project is satisfactory for the populations and the environment.

1-Pi the probability of unsatisfactory (loss of well-being).

$$\boldsymbol{P_i} = E\left(Y_i = \frac{1}{X_i}\right) = E\left(1/\beta_1 Q_{01} + \beta_2 Sexe + \beta_3 Age + \beta_4 RM + \beta_5 ninst + \beta_6 sm + \beta 7NPe + \beta 8Q211a + \beta 9Q212c + \beta 10Q221a + \beta 11Q227 + \beta 12Q242a + \beta 13Q243f + \beta 14Q247c + \beta 15Q248 + \beta 16Q249a + \beta 17Q311c + \beta 18Q324a + \beta 19Q333c + \varepsilon i.\right) \textbf{(1)}$$

Where: $$\boldsymbol{Z_i} = \beta_1 Q_{01} + \beta_2 Sexe + \beta_3 Age + \beta_4 RM + \beta_5 ninst + \beta_6 sm + \beta_7 NPe + \beta_8 Q211a + \beta_9 Q212c + \beta_{10} Q221a + \beta_{11} Q227 + \beta_{12} Q242a + \beta_{13} Q243f + \beta_{14} Q247c + \beta_{15} Q248 + \beta_{16} Q249a + \beta_{17} Q311c + \beta_{18} Q324a + \beta_{19} Q333c + \varepsilon_i$$ **(2)**

From there we have:

$$P_i = E\left(Y_i = \frac{1}{X_i}\right) = 1/1 + e^{-z_i} \textbf{(3)}$$

$$\text{Or } Log\,(P_i/1 - P_i) = Z_i = L_i \textbf{(4)}$$

The logit model is used to measure people's preferences and environmental use when it comes to discrete choices. In this range we also have: the Linear Probability Model (LPM), the Probit and the Tobit for univariate binary models. Our choice is for the Logit almost identical to the Probit at 1.6 points of difference in the results. As for the MPL, it has many problems in the estimation, in particular: the non-normality of the error term, heteroscedasticity, R2 of

limited usefulness because it is deficient, and the probability which is not in the interval [0.1]. And for Tobit, since the data is not censored or corrected, its modeling cannot be used.

3.2. Method of data collection

The reason for this step of 20 is due to the fact that after 20 houses the next household to be interviewed is chosen to ensure that these individuals will be representative for our sample. As part of our field survey, the heads of households selected responded to our questionnaire, which focused on three main points: the identification of the head of household or their socio-demographic categorization, the socio-economic assessment and the environmental assessment of the project. The method used here is that of itineraries with one interviewer per village. The itinerary method, also known as the Politz method, is a non-probabilistic sampling method that forces the interviewer to follow a well-defined path for his or her survey (Carricano et al., 2008). It is mainly used in household surveys, and indicates specific action points where the interviewer should carry out his or her study. It has the advantage of being geographically dispersed.

4. Results And Discussion

Comment [JF3]: This section does not present the state of the art and/or validation of your data. I identified only analysis of results, but there are no literatures to support your data. While evaluating your data, you must validate it. I suggest rearranging this section.

4.1. The challenges of the PPTC: a statistical and descriptive analysis

We have been able to analyse the perverse effects of the project, particularly with regard to the indicators that are:

- Agriculture, with nearly 70% of the arable land crossed by the project and 77.4% resulting from cases of compensatory dissatisfaction,
- Health: the project has led to an increase in STDs/AIDS, noise, and odor nuisance. More than 90% of heads of household say that the operating company and its subcontractors have not paid enough attention to the development and the fight against these diseases.
- Employment and the creation of business opportunities: our fieldwork shows that many residents have obtained jobs since the start of pipeline operations (more than half of the applicants), but for 63.3% of residents, these jobs are precarious. 61.9% of the people with precarious jobs in our survey sample were dissatisfied with the compensation received.
- Water management: non-compliance with environmental regulations has led to disruption in the use of water points in one out of three household. 56.7% of households say that the water corners set up by COTCO and its subcontractors no longer function normally. The restoration of land and the management of cultural and sacred sites have also been negatively affected, including worship places which have been desecrated and graves exhumed.

As mentioned above, the independent variables in our study are: district of residence, gender, age, monthly income, health, level of education, marital status, number of people in employment, price changes, diversification of activities, facilitated travel, employment, water management, management of cultural and sacred sites, land restoration, agriculture.

Table 1: Descriptive statistics from survey data

Variables	Definition	Mean	Min	Max
District of residence	2 modalities			
	1- Ngoumou	125	80	170
	2- Kribi	95	60	130
Monthly Income	4 modalities			
	1- Less than 28 000fcfa			
	2-] 28 000-100 000]			
	3-] 100 000- 200 000]			
	4- more than 200 000			
Health	2 modalities			
	1- Sick	163	110	202
	2- Non Sick	67	40	98
Level of education	4 modalities and 2 sub-modalities in the 2nd modality 1-Primary 2-Secondary 2a- primary cycle 2b-secondary cycle 3-Higher 4-Not in school			
Marital status	4 modalities 1-Maried 2-Single 3-Divorced 4-Widowed			
Number of Person of activity	2 modalities			
	1- Working	167	164	230
	2- Not Working	83	66	70
Modification of prices	2 modalities			
	1- Modified	189		
	2- Not modified			
Diversification of	2 modalities			

activities	1- Diversified 2- Non diversified			
Travel facilities	2 modalities 1- Facilities 2- Non facilities			
Agriculture	2 modalities 1- Satisfied 2- Not satisfied			
Employment	2 modalities 1- Satisfied 2- Non satisfied			
Water Management	2 modalities 1- Crossed 2- Not crossed			
Management of cultural and sacred sites	2 modalities 1- Profaned 2- Not profaned			
Land Restoration	2 modalities 1- Restaured 2- None restaured			

Source: Author's construction

4.2. Econometric analyses of the effects of the PPTC

Following the statistical and descriptive analysis, we carry out the econometric estimation to determine of the CAR.

Hence the table below shows the degree of significance of the different relevant explanatory variables:

Table 2: Logit model

Variables	Modalities	Odds ratio	Z	P>z	Significativity
Sex	Male	Ref	Ref	ref	
	Female	-0.9124492	-1.35	0.176	
Religion	Christian	Ref	Ref	ref	
	Not christian	-1.14614	-1.16	0.248	
Level of	Uneducated	Ref	Ref	ref	

eductation	Primary	-1.075855	-0.94	0.347	
	Secondary	-0.020194	-0.52	0.986	
Age	-	0.9140287	-2.47	0.013	***
Marital Status	Maried	Ref	Ref	ref	***
	Non maried	0.0578006	-2.79	0.005	
Monthly Income	Poor	Ref	Ref	ref	
	Not poor	-0.5776899	-0.74	0. 461	
Health (q221a)	Yes	Ref	Ref	ref	***
	No	19.6885	-2.42	0.015	
Effet sur les prix	Stable	Ref	Ref	ref	
	Not stable	0.1768962	0.16	0.873	
Agriculture (q212c)	Yes	Ref	Ref	ref	***
	No	0.03922	-3.06	0.002	
Gestion de l'eau	Yes	Ref	Ref	ref	***
	No	0.02455	-2.98	0.003	
Gestion des sites culturels et sacred	Yes	Ref	Ref	ref	***
	No	0.08811	-2.16	0.031	
Restauration des terres	Yes	Ref	Ref	ref	
	No	-0.6835626	-0.85	0.398	

Source: Author's construction **NOTE:** Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Variables such as agriculture, health, water management, age, marital status, and management of cultural and sacred sites were found to be very significant for the compensation model and overall, following econometric tests for the validity of the model. Thanks to the Pearson's residual test, the effects on these categories can be seen. The individuals interviewed are those who have suffered the effects of the project because the moustache box shows us that the majority of individuals are well within the range [-2, 2].

5. Conclusion

Comment [JF4]: You do not need to present objective in this section. Do not forget that here you must demonstrate the conclusion of your study, without doubt or uncertainty. I suggest reorganizing clearly and objectively the conclusion of your study.

The objective of our work was to assess the effects suffered by local populations and the environment following the route of the Chad-Cameroon pipeline project in the Littoral-Atlantic zone.

It appears from the above that the operation of the Chad-Cameroon pipeline has economically generated many funds from subcontracting, taxes, royalties, and subsidies. On the social and

environmental level, there has been the construction of some schools, roads, health centers and the creation of protected areas, notably the Campo-Ma'an and Mbam-Djerem parks. However, it must be said that, alongside all these major achievements, there are still a number of important gaps on the social and environmental level.

The use of these profits unfortunately comes up against not only the retrograde mentalities of the rulers, but also the desire of the oil companies to make enormous profits at all costs, thus leading to the detriment of respect for some human values and those of the environment. Thus, problems concerning the profound modification of the well-being of the population (health and income-generating activities) and the environment (water resources, management of cultural and sacred sites, and land restoration).This result tries to explain, the inadequacy of compensation, the discontent of the local population, the neglect of proposals made by NGOs in decision-making and the anarchic destruction of certain social and environmental assets. These problems that have arisen attest to the pre-eminence of the economic aspect over the social and environmental aspects.

On the other hand, through the measurement of consent and the choice of variables for the assessment of the social and environmental impacts of the project, which depends from one individual to another and from one community to another.

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