Integrated Investment Appraisal of Water and Sanitation Projects: A Case of Senegal Water and Sanitation Project.

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ABSTRACT

Senegal's water supply coverage was 75 percent in 2004. Of the 75 percent of the total population. 64 percent of the rural population is covered, and 90 percent of the urban population has access to water. The figures are much lower with sanitation however, with only 33 percent coverage of the entire population of Senegal. Of the 33 percent, 17 percent of the rural population is covered and 57 percent of the urban population is covered.

To further improve the water and sanitation sector of Senegal, especially in the rural areas, the African Development Bank (AfDB) decided to intervene with a series of engagement. The study is the appraisal of a water and sanitation project which is the first phase of the African Development Bank's (AfDB) engagement in rural water and sanitation in Senegal. This initiative is directed towards ensuring that Senegal reaches the millennium development goals it signed up for. The intervention is structured such that it takes care of the water supply infrastructure, the sanitation infrastructure and the renewal of the unified framework of implementation. This study is an appraisal of this project, and the impact it has on all major stakeholders. The Cost-Benefit Analysis (CBA) done in this study employs the Integrated Investment Appraisal Approach (IIA) which typically includes the financial, economic, stakeholder and risk analyses of the project.

Keywords: Water and sanitation sector, Senegal, African Development Bank, Cost-Benefit Analysis, Integrated Investment Appraisal Approach, Financial Analysis, Economic Analysis, Stakeholder/Distributive Analysis, Risk Analysis

ÖZ

Senegal’in su temini kapsama alanı 2004’te yüzde 75’di. Toplam nüfusun yüzde 75’inden. Kırsal nüfusun yüzde 64'ü kaplıdır ve yüzde 90'ı kentsel kapsamlıdır. Rakamlar sanitasyonla çok daha düşük, ancak Senegal'in tüm nüfusunun sadece yüzde 33'ünü kapsıyor. Kırsal nüfusun yüzde 17'si kapsanıyor ve kentsel nüfusun yüzde 57'si kaplanıyor.

Özellikle kırsal bölgelerde Senegal'in su ve sanitasyon sektörünü daha da geliştirmek için Afrika Kalkınma Bankası (AFDB) bir dizi müdahaleye müdahale etmeye karar verdi. Çalışma, Afrika Kalkınma Bankası'nın (AfDB) Senegal'deki kırsal su ve sanitasyonun ilk aşaması olan bir su ve sanitasyon projesinin değerlendirilmesidir. Bu girişim Senegal'in imzaladığı binyıl gelişim hedeflerine ulaşmasını sağlamaya yöneliktir. Müdahale, su temini altyapısı, temizlik altyapısı ve birleştirilmiş uygulama çerçevesinin yenilenmesi ile ilgilenecek şekilde yapılandırılmıştır. Bu çalışmada yapılan Maliyet-Fayda Analizi (CBA), tipik olarak projenin finansal, ekonomik, paydaş ve risk analizlerini içeren Entegre Yatırım Değerlendirme Yaklaşımı'nı (IIA) kullanmaktadır.

Anahtar Kelimeler: Su ve sanitasyon sektörü, Senegal, Afrika Kalkınma Bankası, Fayda-Maliyet Analizi, Entegre Yatırım Değerleme Yaklaşımı, Finansal Analiz, Ekonomik Analiz, Paydaş / Dağıtım Analizi, Risk Analizi

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LIST OF ABBREVIATIONS

ADSCR	Annual Debt Service Coverage Ratio
AfDB	African Development Bank
ASUFOR	User Association of Rural Boreholes
CBA	Cost Benefit Analysis
CFA	Communauté financière d'Afrique
CF	Conversion Factor
ENPV	Economic Net Present Value
FNPV	Financial Net Present Value
GoS	Government of Senegal
IIA	Integrated Investment Appraisal
MDGs	Millennium Development Goals
Mill	Million
NPV	Net Present Value
SDG	Sustainable Development Goals
SSA	Sub-Saharan Africa
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations International Children Emergency Fund
USAID	United States Agency for International Development
USD	United States Dollar
WEDC	Women's Economic Development Council.
WHO	World Health Organization

WSS	Water Supply and Sanitation
XOF	West African CFA Franc

Chapter 1

INTRODUCTION

1.1 Background

Located in the western part of Africa, Senegal shares borders with Guinea, Guinea-Bissau, Mauritania, and almost completely encloses Gambia on the inside. As is the case with many African countries, Senegal houses people with diverse ethnicity. Although most people use their native language for their day to day activities, French is the official language. More than half of the country's population is located in coastal areas where most economic activities take place.

At the time of the project, the population of Senegal was about 10 million people. The population is distributed such that about only about 47 percent of them live in the urban areas of the country, while the remaining portion of the populace live in the rural areas. Furthermore, there was in 2005, a wide disparity of over 17 percent in the rural and urban unemployment rates. The rural parts of the country had an unemployment rate that was over 40 percent, whereas the urban unemployment figure stood at about 23 percent. The major source of employment for over three-quarters of the country's working population is agriculture, and more than half of the population is below the age of 20 (Department of Statistics, 2006). These figures point to the fact more attention should be given rural areas of Senegal, if the country is to develop.

According to the Department of Statistics, Republic of Senegal, the rural areas of the country should increase from a total number of about 6.25 to about 7.68 million people from 2005 to 2015. This depicts a growth rate of about 2.1 percent over the said period. Each household is estimated to have about 9.6 members. Thus, the number of households is expected to grow from about 49,200 to 793,200 households.

1.2 Importance and Objectives

In order to make suitable provision for drinking water and adequate sanitation for the people of Senegal, the Government of Senegal with support from the World Bank and the United Nations established a water and sanitation program in the '70s. Nonetheless, water consumption per capita is still relatively low. Until recently when the country adopted millennium development goals, the programme was unable to keep up with the ever increasing demand, notably in the rural areas. This is due to lack of necessary financing and institutional framework. It has therefore become an issue of paramount importance to expand the supply of potable water in the remote areas of Senegal. In the next chapter, the initiatives taken by the government of Senegal with help from organizations around the world are explained. This study is an appraisal of one of such initiatives.

1.3 Study Methodology

It is imperative that projects be analyzed in light of their financial and social viability, such that scarce resources are spent on projects that are not only financially sustainable, but also increase the well-being of the people. Cost Benefit Analysis goes a long way in achieving this (Jenkins, Kuo, & Harberger, 2014).

The analysis of the project was done such that the financial, economic, stakeholder and risk analyses were integrated. In order to achieve this, the Integrated Investment Appraisal (IIA) approach of analyzing costs and benefits of project was employed

The data obtained from both primary and secondary sources were analyzed in light of the tenets of the IIA approach. This was done with a financial model with which analyses were carried out, and conclusions drawn. The criteria used in the determination of the financial and social viability of the project is the Net Present Value (NPV) which was obtained from the analyses. Furthermore, using the same model, sensitivity analysis was run to determine the critical variables by observing the impact of their variations in the overall success or otherwise of the proposed project. The analysis concludes with a risk analysis of the project, and suggests ways through which the risks can be mitigated.

1.4 Thesis Structure

The introductory section of the thesis is contained in Chapter 1. The section is concerned with providing a concise background of the country of interest, and to provide some insight into the objectives of the study as a whole. Closely followed by the second Chapter which sheds light into the general idea of the study by taking a look at the general situation of water and sanitation in Senegal and the efforts by the GoS to improve the accessibility and availability of water and improved sanitation especially in remote areas. Chapter 3 discusses the project in detail, and Chapter 4 focuses on the methodology used for this study.

Pursuant to the fact that the IIA approach was used in the analysis, the remaining chapters of the thesis concerns themselves with the tenets of the employed

methodology. The 5th chapter contains the financial analysis, chapter 6 focuses on the economic analysis and Chapters 7, 8, and 9 looks at the stakeholder analysis, the risk analysis, and the conclusion of the study, respectively.

Chapter 2

OVERVIEW OF THE STUDY

Development in many countries have been plagued with several obstacles. A major clog in the wheel of development in a number of countries is the inadequate supply of water and sanitation services. In fact, the World Health Organization (WHO) estimates daily death of over 3500 children under the age of five as a result of inadequate supply of water and sanitation services. An estimated amount of over 2.5 billion people are subjected to water sources that are far from ideal, and sanitation systems that are not safe for human existence. It is therefore not farfetched that a significant number of people are victims of bad health conditions that hamper their productivity, and reduces the number of opportunities they can take to make progress in life. Diarrhoea (largely water-borne) is the third largest cause of morbidity and the sixth largest cause of mortality in the world (Pond, Rueedi, & Pedley, 2004). A multifaceted review of the health effects from improved water supply and sanitation showed that there is an undeniable link between a significant reduction in the severity and prevalence of diarrhoea and infectious diseases as a result of improved water supply and sanitation (Esrey, Potash, Roberts, & Shiff, 1991). Almost 60% of infant mortality is linked to infectious diseases, most of which are water-, sanitation-, and hygiene-related (UNESCO, 2003).

The unequivocal consequence of diseases are not the only effects of lack of basic water needs (Montgomery & Elimelech, 2007). Water is mainly collected by women and

children, and its scarcity represents an extra burden on them. Collectors can spend up to 6 hours in search of water to meet household needs (WHO/UNICEF, 2005). This is time that could have been used in a number of other productive activities. The developing world is still plagued with diseases associated with poor water and sanitation. In 2003, an estimated amount of 4% of the global burden of disease and 1.6 million deaths per year were due to unsafe water supply and sanitation (WHO, 2003). In Africa, about 40% of the population do not have access to improved water supply and sanitation (WHO, 2000).

2.1 Water and Sanitation in Senegal

Senegal's water supply coverage was 75 percent in 2004. Of the 75 percent of the total population. 64 percent of the rural population is covered, and 90 percent urban is covered. The figures are much lower with sanitation, however, with only 33 per cent coverage of the entire population of Senegal. From which, 17 percent of the rural population is covered and 57 percent of the urban population is covered.

Senegal, located on Africa's west coast, hosts one of the most developed water supply and sanitation (WSS) sectors in sub-Saharan Africa (SSA). However, the country is still faced with crucial challenges. One of these challenges is the unequal access to potable water and sanitation services in urban and rural areas (World Bank, 2018). These inequalities impact the poorest users in terms of quality and cost of services. In addition, the supply modes (private connections vs. standpipes or piped water vs. wells) show significant variations throughout the country. There are particular concerns related to the coverage of sanitation facilities and services in rural areas.

Sanitation is still quite poor especially in Senegal, this is more evident in the remote areas. A miserly 17% of the households had access to water at the time (WHO, 2003). Furthermore, there was no unified network for getting rid of the household's excreta and wastewater. This situation therefore meant that contributions must be made to the capital cost requirement of the installation of domestic sanitation systems. This contribution could either be financial, or through the supply of labour. The lack of systems however wasn't the only reason for such deplorable state of water and sanitation systems. Lack of education is also responsible, especially concerning issues relating to safe hygiene is also responsible.

2.2 Initiatives to Improve Water and Sanitation in Senegal.

The reformation of the water and sanitation sector of Senegal began as far back as 1966. Senegal is part of the UN countries that signed up for the Millennium Development Goals, these strides are thus in the direction of meeting these targets. The overall management of this sector has been improved in terms of quality of service delivery, efficiency of operations and cost recovery. These improvements were achieved by institutional reforms. In fact, Senegal is regarded as a model for public-private partnership in sub-Saharan Africa and has been replicated in other African countries. (USAID, 2010). The government's commitment to a credible reform attracted a positive response from traditional financiers of urban water in Senegal. In 1996 alone, US$290 million was raised to support the development of the urban water and sanitation sector (Matar, Philippe, Alain, & Richard, 2009).

The major components of the reform included ensuring that the management and rational organization of the sector were given autonomy; supporting improvements in commercial management and cost-effectiveness; establishing a new rate policy for

improving cost recovery and reaching a financial equilibrium of the urban water sub-sector.

At the end of 2013, the urban sector achieved a financial equilibrium. This is largely due to a gradual decrease in subsidies and a gradual increase in tariffs over the course of a number of years. In the urban areas of Senegal, the outlook of water and sanitation has been quite positive. However, the same cannot be said about the rural areas of Senegal which still requires a lot of progressive strides. User Associations of Rural Boreholes (ASUFOR) have been used as instruments of the implementation of an innovative water management approach. The logic behind this is to have all boreholes under private management contracts. It must be said that this method has brought much improvement to access to water in the rural areas, however, a similar system hasn't been implemented for the sanitation sub-sector (USAID, 2010).

2.3 The Proposed Project

The proposed project is directly concerned with the water and sanitation systems in selected areas of rural Senegal. It is directed towards ensuring that Senegal reaches the millennium development goals it signed up for. The intervention is structured such that it takes care of the water and sanitation infrastructures, and the renewal of pre-existing programs put in place to improve water and sanitation.

Chapter 3

PROJECT DESCRIPTION

3.1 Project Concept

It is almost impossible to talk about development in any form without proper provision for water and sanitation. As they say “water is life”. The linkage between basic water and sanitation services with other dimension of poverty means that the importance of adequate water and sanitation supply cannot be overemphasized. It is to this end that inherent in the millennium development goals is the issue of water and sanitation. Millennium Development Goal 7, Target 10 is to reduce the proportion of people who do not have sustainable access to safe drinking water and basic sanitation by 2015 (WHO/UNICEF, 2004). The consequences of inadequate water supply are felt mainly by the poor who as a result of bad supply by the formal sector, have to make their own often inadequate arrangements to cater for their basic need for water. A good number of them walk long distances to get water, or pay exorbitant prices to water vendors for little volume of water (Bosch, Hommann, Rubio, Sadoff, & L., 2001). Although as earlier stated, Senegal isn’t doing too poorly with the access that people in Senegal (especially the urban area) have to water, there is still need for improvement especially in the rural areas as access to water in these regions are still significantly low. Unfortunately, the same cannot be said about the sanitation sector where Senegal is seriously lagging behind, and as such more work should be done in the sector.

This project (rural water and sanitation program) seeks to address the areas where Senegal is still lacking. The project is in line with the millennium development goals signed up for by Senegal. The program aims to increase the number of people with access to water in selected rural areas, improve the nature of access. This means that some people who didn't have access to water through house connections now do, people who had water through other means for example streams, now have access to water through standpipes. The program doesn't just increase the number of people with access and nature of access, it also increases the volume of water available to each category of access. The program also involves improvement in the sanitation sector of selected rural areas in Senegal. This will ensure that more people have access to better sanitation, and as a result, fewer people suffer from the effects of bad sanitation. The social economic benefits of this program will be discussed in greater details in the economic analysis.

3.2 Project Components

The project is divided into three major parts. The first part deals with the infrastructure of the water supply, the second tackles the sanitation systems, and the last part of the project is an attempt to revive and maintain the pre-existing water and sanitation programs in rural Senegal.

3.2.1 The Infrastructure of Water Supply

This part of the project is mainly concerned with first, improving the volume of water previously available to people who without the project had some access to water, and also improving the quality of access of some of the people who without the project had a reasonable[1] access. More about this is discussed later in the study. In addition, the project also seeks to give access to people who without the project did not have a viable

[1] WHO defines reasonable access to water as having access within 1 kilometer.

access to water. The project expects to achieve this goals by installing 75 water pumps, 500 production and distribution meters, 20 boreholes, 232 networks and water adduction works, and finally, 31, 854 household connections.

3.2.2 Sanitation Infrastructure

It is difficult to talk about development, without sanitation systems in place (Evans, 2004). Sanitation is the way by which excreta and community liquid waste are collected such that they do not endanger the health of the populace of the community. Options which involve disposal of human waste without treatment of any kind are not part of this definition (Maurer, Bufardi, Tilley, Zurbrügg, & Truffer, 2012). Rural areas in Senegal still lack a sewage network, hence, the only available option is the autonomous sanitation systems. These are systems that typically do not have a need for instant evacuation of excreta. They are instead designed such the bad odor never gets out. They usually have two septic tanks so that, the excreta are passed onto the empty tank as soon as the other one gets full. Hence, the second component of the project is thus targeted towards improving significantly both public and private sanitation systems.

The last part of the project deals with the renewal of pre-existing water and sanitation coordination initiatives by the World Bank, and injecting some money into their smooth running. As such, major stakeholder in the water and sanitation sector of the selected areas are educated and trained. Furthermore, the issue of lack of education by the locals concerning ideal hygienic practices is tackled.

3.3 Selected Areas of Coverage by the Project

The areas that the program aims to cover are as shown in Figure 1. The areas are Louga, Kolda and Ziguinchor areas of Senegal.

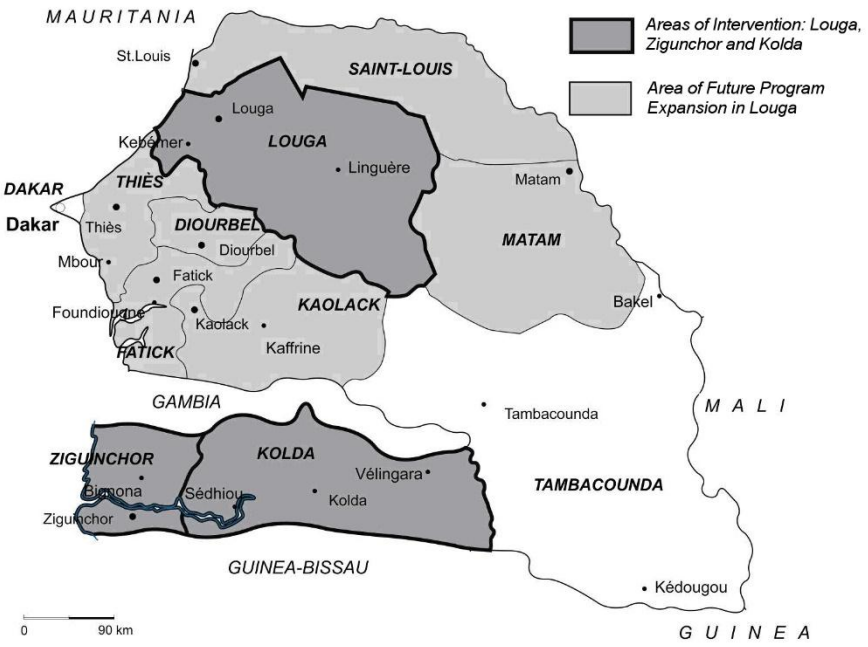


Figure 1: Areas of Program Coverage

Details of the demographic structure, access to water and access to sanitation of the selected areas are shown in Table 1.

Table 1: Target Population (AfDB feasibility study)

Indicator	**Total**
Demographics	
i. Rural Population (2005)	1,591,800 People
ii. Average Household Size	9.63
iii. School Age Children (5-15)	30% of Population
Access to Safe Water	
i. Share of population with access to safe water without the project	64% of Population
Access to Sanitation	
i. Access to individual sanitation without the project	17% of Population
ii. Access to public sanitation without the project	20% of Population
iii. Population newly served with individual sanitation	171,500

iv.	Population newly served with public sanitation	831,334

Note:

1. The population newly served with individual sanitation is obtained by taking the product of the proposed individual sanitation systems and the household size.
2. Sanitation is expected to be provided in every public institution.
3. The emigration (rural-urban migration) and the population growth rates are almost the same, therefore they are assumed to cancel out.

3.4 Program Cost and Financing

Approximately US$ 40.3 million which is about XOF[2] 20,000 million, in current prices was budgeted for the project. Table 2 shows the breakdown of the investment costs.

Table 2: Investment Costs by Component (Million XOF)

Category	Item	Unit Cost (Mill XOF)	Units	Total (Mill XOF)
Water Supply Infrastructure	Pumps	14	75	1,050
	Production and distribution meters	0.1	500	50
	Boreholes	40	20	800
	Water works and networks	25	232	5,800
	Household connections	0.7	31,854	2,230
	Total Cost			**9,930**
Sanitation Infrastructure	Domestic sanitation systems	0.25	17,809	4,452
	Public sanitation systems	4	500	2000
	T**otal Cost**			**6,452**
Unified Framework of Intervention				3,770
TOTAL INVESTMENT COST				**20,152**

[2] XOF is the West African CFA

Most of the funds used to finance the investment cost came from African Development Fund in form of a grant. Households who are beneficiaries of household connections and sanitations however contribute to the investment cost, while the rest of the investment cost is financed the Government of Senegal. The government also committed itself to replace the public latrines after the useful life. Similarly, the households are responsible for the replacement of household connections and domestic sanitation systems after the useful life of these assets. Table 5 shows the assets and their respective useful lives. It must be noted that the role played by the government and beneficiaries in financing some of the investment costs is just to give them a sense of responsibility for the project. Table 3 shows the various sources of funds and the amount.

Table 3: Sources of Funds

Source	**Million US$**	**Million XOF**
African Development Fund	35.00	17,500
Government	4.40	2,200
Households	0.904	452.0
1. Households direct	*0.420*	*210*
2. Households through ASUFORs	*0.484*	*242*
Total	**40.304**	**20,152**

Finally, on the project description, users of water in rural areas of Senegal usually elect a group of people to maintain and manage investments in water supply. At the time of the implementation of this project, these selected officials here and after are referred to as ASUFORs account for over 300 local water supply systems. This model was adopted by the project. As such, the ASUFORs are responsible for the maintenance and operating of the water supply infrastructure with oversight by the project coordination unit.

Chapter 4

METHODOLOGY

This study was done using the Integrated Investment Approach (IIA). This method is a way of carrying out Cost-Benefit Analysis (CBA) such that the financial, economic, stakeholder, distributive and risk analysis are done. Traditional approaches to investment appraisal usually involves a separate analysis of the investment from a financial point of view, and an economic analysis that stands alone. IIA approach on the other side, integrates the financial and economic analyses. As soon as this is done, the analysis proceeds into the identification, measurement, and allocation of the impacts of the project on the stakeholders (Jenkins, Kuo, & Harberger, 2014). The risk analysis which becomes a serious issue when the project goes into future years is carried out as well. The following sections give detailed explanation of how each of the section of the IIA approach works.

4.1 Financial Analysis

The financial analysis is carried out to determine the financial viability of the project. Before the analysis goes into the economy as a whole, IIA begins with the analysis of the financials of the project. Investors, and lenders need to know if the investment will yield positive returns, and the lenders need to know if the project will be able to repay its debts. As such, the financial analysis is carried out from the investor and banker's perspectives. From the banker's perspective, the analysis is done first without taking into the account the loan. This allows the lenders to see if the project can generate enough cash flow to service its debt requirements. The Annual Debt Service Coverage

Ratios (ADSCRs) are calculated from this cash flow. The ratios are then used by the bank and other lending institutions to see if financing the project is worthwhile.

The financial analysis from the investor's perspective is mainly different from the banker's perspective in that it takes into consideration the loan, that is the financing part of the project. Here, the aim is to evaluate the returns the project generates after taking care of all its costs including the loan repayment. The overall Financial Net Present Value (FNPV) of the project is then calculated. Typically, a project is said to be financially viable if it has a positive FNPV. A very important part of the analysis is the incremental analysis. This is the difference between the financial cash flow and "with" the project and "without" the project. This gives a clear idea on the financial impact of the project.

4.2 Economic Analysis

Typically, analyzing a project from an economic perspective is an attempt to identify and measure what impact the project has on the well-being of the society. This section of the IIA seeks to find out if the project increases or decreases the net benefit of the society when considered as a whole. Founded on the principles of welfare economics, the economic appraisal of projects has its roots in these three postulates.

1. The competitive demand price for an incremental unit of a good measures its economic value to the demander, and hence, its economic benefits.
2. The competitive supply price for an incremental unit of a good measures its economic resource cost.
3. Costs and benefits are added up with no regard to who the gainers and losers are (Jenkins, Kuo, & Harberger, 2014).

The difference between the financial and economic analysis arises majorly from the presence of distortions. In cases where there are no distortions, the demand and supply prices will be clear, and will be the same as the financial price. However, this is hardly ever the case in reality. This is because in reality distortions like personal and corporate income taxes, value-added tax, tariffs on imports, excise duties, and different kind of subsidies are commonplace in a typical country. And these distortions have undeniable impacts on value of foreign exchange, economic value of capital, and so on. As a result, these distortions are factored into the economic analysis so as to get the real economic costs and benefits of the project being appraised. For example, if a project is using a subsidized input, the financial cost of these inputs will underestimate its true economic cost. It is the greater economic cost however, that will be reported in the economic analysis, not the lower financial value of the item whose price has been reduced by the subsidy. Furthermore, non-tax distortions such as environmental pollution are costs to the society and as such must be included in the economic analysis.

Similar to the financial analysis, the economic cash flow is generated quantifying the economic benefits and costs of the project. To move from financial analysis to economic analysis, financial prices must be substituted with the economic prices by the use of conversion factors. These conversion factors are calculated such that they reflect the true cost and benefit of the inputs used by the project, and the output produced by the project. Conversion factors are simply the ratio of the economic value to the financial value. More details about the calculation of the conversion factors used for this study is given in the economic analysis chapter. As is the case with financial analysis, the incremental economic cash flow is obtained, after which the Economic Net Present Value (ENPV) is calculated. A positive ENPV shows that the project is a

good one from the perspective of the society as a whole, and as such governments, and other agencies may be willing to fund or embark on such project.

4.3 Stakeholder Analysis

This is the part of the IIA that involves the analysis of the losers and those who benefit from the project. It proceeds to measure the quantity of the loses and benefits as the case may be. The financial and economic analyses serve as foundation on which the stakeholder analysis is built. Also called the distributional analysis, the stakeholder analysis is conducted so that it can be clear if the groups that are targeted by the project actually receive the intended rewards as a result of the project, and to see to it that no group is made to bear unfair amount of the project cost. Major stakeholders of a typical project are consumers, project's suppliers, government, and specific people in the economy. In this study for example, the project is aimed at enabling Senegal to achieve its MDG goals, and the stakeholders include the government, the providers of the required funds, and more importantly the people of the targeted rural areas, among others. The stakeholder analysis shows if indeed the goal is achieved.

4.4 Risk Analysis

As described earlier, the fact that the project runs into future years means there are uncertainties that need to be accounted for. This makes the risk analysis an integral part of the IIA method of appraising projects. For example, variables like the exchange rate may have huge impacts on the success of the project, especially when finances are sourced for in foreign currency, or capital investments have to be imported. To determine the sensitive variables, a sensitivity analysis can be carried out. This is done by changing a particular variable with different magnitudes and seeing the corresponding impact on the NPV of the project. A sensitive variable will be such that a change in the variable will significantly affect the outcome of the project being

analyzed. After the sensitivity analysis have been carried out to determine the sensitive variables, the Monte Carlo simulation is run. This has probability distributions embedded in it, and it shows several risk level scenarios with their effects on the success or failure of the project.

Risk analysis is of paramount importance because it allows the stakeholders to have a reasonably full understanding of the risks involved in the project, as such, strategies to contain and mitigate these risks can be determined, and carried out. Contracts that allows the risk to be distributed such that the stakeholder that is most capable of bearing a particularly is given the responsibility of the risk is one of the ways the risks can be contained. The importance of risk analysis cannot be overemphasized as the project goes into the future, and the future is unknown. Therefore, provisions must be made in case future reality is different from the projections as often times is the case.

Chapter 5

FINANCIAL ANALYSIS

Financial analysis seeks to determine the financial feasibility of a project. It usually serves as the foundation on which other analysis for capital investments are built. It deals with the quantity projection of expenditures and revenues that the project is expected to generate. It also tackles the financing of the project and brings to fore the ability of the project to finance its operations, and investment costs.

Financial analysis involves a forecast of these revenues and expenditures, and as such, for the analysis to be meaningful, consistent prices must be used. This means that inflation must be factored into the financial analysis. The assumed rate of inflation in the base case, together with the real interest rate and the real foreign exchange rate must be clearly stated, and combined consistently. This makes the forecast of expenditures and revenues of the project in current prices possible (Jenkins, Kuo, & Harberger, 2014).

Financial analysis of a project must also take into consideration the timing of cash receipts, and expenditures. As such, these must be adjusted for changes in accounts receivable and accounts payable, for revenues and expenditures respectively. The financial analysis can be done from the perspectives of the various stakeholders involved in the project.

5.1 Parameters and Assumptions

The following section presents the main assumptions and parameters that were used in the financial analysis of the project.

5.1.1 Quantity of Water Supply

There are typically three means of getting water in the selected areas without the project. These sources are household connections, stand pipe/post, and other access. Without the project, household connection users had access to 20 liters of water in a day (per person), stand pipe/post users had 15 liters, and users who have other informal access to water are only able to get about 10 liters in a day. As discussed earlier, the project not only looks to improve the volume of water available to the populace of the targeted areas. it also seeks to improve nature of the access. Without the project, 64% of the population in the selected areas had reasonable access to water. Of these people, only 10% of them had access to water through household connections, and the remaining 90% only had access to water through stand pipe/post.

There was another category of people who are deemed not to have a reasonable access to water, they got water from streams and other access. With the project, the share of population with access to household connection increased to 34%, leaving only 66% with stand pipe/post connection. However, the entire population of people who did not have a reasonable access to water were moved into the stand pipe/post category. Household users could initially obtain 20 liters of water per person daily, and stand pipe/post users had access to 15 liters of water a day. Other access users only had 10 liters per day. With the project however, household users had access to 40 liters of water per day, stand pipe/post users had access to 30 liters (this includes people who initially had no reasonable access, but now have access to water through stand

pipe/post). Water availability is assumed to be 60% in the first year of operation, 80% in the second year, and it stays at 100% over the evaluation period.

5.1.2 Price of Water

As stated earlier, this project was operated and maintained by the ASUFORs. The sales of water occur either through stand pipe/post, or house connections. The tariff is currently set at 200 XOF/m^3 for house connections, and at 5 XOF/bucket at fountain for buckets of 25 liters. Although the tariffs on water is largely a political decision, the study assumes that the prices are adjusted for inflation after every 3 years.

5.1.3 Sanitation

Without the project, about 17% of the population had access to private sanitation, and 20% had access to public sanitation systems. With the project, additional 17,809 households will be served with private sanitation, (obtained from the number of household systems installed) and another 831,334 people will have access to public sanitation (The project seeks to provide public sanitation in all public institutions as such everyone in the target areas have access to some form of sanitation).

Aside of contribution made by beneficiaries to the investment costs, nothing is charged for sanitation.

5.2 Operating and Maintenance Cost of ASUFORs

The bulk of the operating cost for this project arises from labour and fuel costs. To pump water, a value of 0.13 fuel oil/m^3 is assumed, and the cost of fuel is taken to be 400 XOF/liter. Additionally, there are annual maintenance costs of 1,000,000 XOF.

The project requires the establishment of 5 new ASUFORs in the first year of operation. The number went up to 8 in the second year, and finally reached 10 ASUFORs in the third year of operation, and remain the same onwards.

Table 4 shows the composition of a typical ASUFOR, and the corresponding labour cost:

Table 4: Summary of ASUFOR Composition and Cost

Category of worker	**Wage rate per month**
2 borehole operator/conductor	60,000 XOF
1 standpipe vendor	75,000 XOF
1 manager	50,000 XOF

A real wage growth of 1.5 percent and a labour productivity growth rate of 0.5 percent per annum is assumed.

5.2.1 Working Capital

The ASUFOR's working capital comprises of an accounts receivable of 10 percent of house connection sales, 5 percent of inputs purchases in accounts payable, and 2 percent of total sales to be kept as cash balances.

5.2.2 Life of Assets and Residual Values

Table 5 gives the summary of assets and their expected life spans.

Table 5: Assets and their life spans

ASSETS	LIFE SPAN
Pumps	5 years
Production and distribution meters	3 years
Boreholes	25 years
Water works and networks	25 years
Household connections	10 years

5.2.3 Taxation

The ASUFORs are exempted from tax obligations.

5.2.4 Inflation and Exchange rate

The domestic inflation rate is assumed to remain at a level of 2% per annum all through the evaluation period, and the US inflation is assumed to be 2.5%. An exchange rate of 500 XOF/USD was used.

5.2.5 Required Rate of Returns

The real opportunity cost of capital for this project is assumed to be 12%.

5.3 Results of Financial Analysis

The financial analysis is carried out mainly to see if the ASUFOR are able to generate enough cash flow to keep up with their operation and periodic maintenance over the lifetime of the project. Other investment costs aside the ones incurred by the ASUFOR cancel out as the financial analysis is done from the ASUFORs' perspective. The ASUFOR incurs about 1.2 % of the total investment cost, and it incurs all the maintenance and operational costs over the life of the project. These expenditures are

included in the financial analysis. In addition, the ASUFOR generates financial revenues from the sales of water to beneficiaries. This financial receipts are also included in the analysis.

Table 6 presents the financial outflows and inflows from the perspective of the ASUFORs.

Table 6: Financial Cash Flow Statement (ASUFORs Point of View in Million XOF)

INFLOWS	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Revenue from sales of water	-	1,866	2,444	3,022	3,022	3,022	3,022	3,022	3,022	3,022	3,022	3,022	3,022	3,022	3,022	3,022	3,022	-
Change in account receivable	-	(51)	(17)	(21)	-	-	(5)	-	-	(5)	-	-	(5)	-	-	(5)	-	83
Residual value, Pumps	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Residual value, meters	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33
Residual value, boreholes water works and networks	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,376
Payment By Beneficiaries	210	-	-	-	-	-	-	-	-	-	-	6,682	-	-	-	-	-	-
AfDB Grant	17,500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Government Contribution	2,200	-	-	-	-	-	-	-	-	-	-	2,000	-	-	-	-	-	-
Total Cash Inflow	**19,910**	**1,815**	**2,427**	**3,001**	**3,022**	**3,022**	**3,017**	**3,022**	**3,022**	**3,017**	**3,022**	**11,704**	**3,017**	**3,022**	**3,022**	**3,017**	**3,022**	**2,493**
OUTFLOWS																		
Cost of pumps	1,050	-	-	-	-	-	1,050	-	-	-	-	-	1,050	-	-	-	-	-
Cost of production & distribution meters	50	-	-	-	50	-	-	-	50	-	-	-	50	-	-	-	50	-
Cost of boreholes	800	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cost of water works and networks	5,800	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cost of household connections	2,230	-	-	-	-	-	-	-	-	-	-	2,230	-	-	-	-	-	-
Cost of domestic sanitation systems	4,452	-	-	-	-	-	-	-	-	-	-	4,452	-	-	-	-	-	-
Cost of gathering points	2,000	-	-	-	-	-	-	-	-	-	-	2,000	-	-	-	-	-	-
Cost of unified framework of intervention	3,770	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fuel cost	-	451	601	751	751	751	751	751	751	751	751	751	751	751	751	751	751	-
Total labor cost	-	34	54	91	92	93	94	95	96	97	98	99	100	101	102	103	104	-
Maintenance cost	-	15	24	40	40	40	40	40	40	40	40	40	40	40	40	40	40	-
Change in account payable	-	(23)	(8)	(8)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	37
Change in cash balance	-	34	11	14	-	-	3	-	-	3	-	-	3	-	-	3	-	(56)
Total Cash Outflow	**20,152**	**511**	**683**	**889**	**933**	**884**	**1,938**	**886**	**937**	**891**	**889**	**9,572**	**1,994**	**892**	**893**	**897**	**945**	**(19)**
Net Cash Flow	**(242)**	**1,304**	**1,745**	**2,112**	**2,089**	**2,138**	**1,079**	**2,136**	**2,085**	**2,126**	**2,133**	**2,132**	**1,023**	**2,130**	**2,129**	**2,120**	**2,077**	**2,511**

As seen in Table 7, the ASUFOR generates a positive net cash flow throughout the life of the project. Using the discount rate given above (12%), the project generates a positive Financial Net Present Value of about 13,056.54 million XOF which translates into approximately 326 million XOF per ASUFOR created as a result of the project.

Table 7: Net Cash Flow

Required ROE for ASUFORs	12.00%	*%*
ASUFORs FNPV	**13,056.54**	*Mil XOF*

5.4 Financial Sensitivity Analysis

The lack of knowledge of what happens in the future brings about uncertainty, and this consequently requires that a sensitivity analysis be conducted. The analysis changes a project parameter as shown in the tables below, and displays the impact of this change on the success or failure of the project. A variable like fuel prices is not decided locally, and as such might be subject to a relatively high degree of variability. Sensitivity analysis changes one variable at a time, and keeps all other factors constant, thus isolating the impact of the variable being changed.

5.4.1 Fountain Price per Bucket

Table 8 shows the sensitivity of the FNPV to changes in the fountain price per bucket. As seen from the table, a reduction in the price by 2 XOF from 5 to 3 XOF per bucket brings about a reduction of about 59 percent in the FNPV, similarly, an increase by 2 XOF from 5 to 7 XOF brings about an increase of about 59 percent in the FNPV of the project from ASUFOR's perspective.

Table 8: Fountain Price per Bucket

PRICE PER BUCKET (XOF)	FNPV (Million XOF)
Base Case	13,057
1	(2,518)
3	5,269
5	**13,057**
7	20,844
9	28,631
11	36,419

5.4.2 Fuel Cost

As seen Table 9, a 5 percent decrease in fuel prices brings about an increase in the FNPV of the project from 13,057 million XOF to 13,298 million XOF. Similarly, if the fuel cost per liter goes up by 25 percent, the FNPV of the project decreases to about 11,851 million XOF.

Table 9: Fuel Cost

PERENTAGE CHANGE IN FUEL COST PER LITER	FNPV (Million XOF)
Base Case	13,057
-10%	13,539
-5%	13,298
0%	**13,057**
5%	12,815
10%	12,574
15%	12,333
20%	12,092
25%	11,851
30%	11,610
35%	11,369
40%	11,128

5.4.3 Water Availability Factor

A reduction in the water availability factor from 100 percent to 50 percent decreases the FNPV of the project by about 43 percent to 7,440 million XOF. However, if the water availability is at 110 percent, the FNPV increases by about 9 percent to 14,180 million XOF. The sensitivity of the FNPV to changes in water availability factor is shown in Table 10.

Table 10: Water Availability Factor

WATER AVAILABILITY FACTOR	FNPV (Million XOF)
Base Case	13,057
50.00%	7,440
60.00%	8,564
70.00%	9,687
80.00%	10,810
90.00%	11,933
100.00%	**13,057**
110.00%	14,180

5.4.4 Investment Cost Overrun

Table 11 shows that a 5 percent decrease in the total investment cost will bring about approximately 8 percent increase in the FNPV, and an increase in the investment cost by 20 percent reduces the FNPV by about, 32 percent.

Table 11: Investment Cost Overrun

INVESTMENT COST OVERRUN	FNPV(Million XOF)
Base Case	13,057
-10%	15,124
-5%	14,090
0.00%	**13,057**
5%	12,023
10%	10,989
15%	9,955
20%	8,921
25%	7,888

5.5 Conclusion of Financial Analysis

The financial analysis shows that the project generates enough cash flow using base case assumptions, for the ASUFOR's to operate and maintain the water and sanitation system all through the evaluation period. The project generates a Financial Net Present Value of about 13,057 million XOF; this translates to about 26.1 million USD[3]. The biggest threats to the financial success of the project as seen in the sensitivity analysis is the fountain price per bucket, water availability, and investment cost overruns. More about how these factors can be dealt with is discussed in chapter 8. It must be noted that the analysis was carried out in real prices.

[3] Using an exchange rate of 1 USD=500 XOF

Chapter 6

ECONOMIC ANALYSIS

6.1 Introduction to Economic Analysis

The previous chapter is concerned with analyzing the financial feasibility of the project by considering the cash receipts and expenditures of the ASUFOR, as they are responsible for operation, and maintenance of the project over the evaluation period. The economic analysis however looks at the society as a whole. As such through the economic analysis, we are able to decide if or not the project improves the net wealth of the society.

6.2 Economic Parameters and Assumptions

6.2.1 National Variables

A value of 12 percent was assumed for the Economic Cost of Capital (EOCK) in Senegal. This is the economic discount rate used by the African Development Bank

Foreign Exchange Premium (FEP) and Non-tradable outlay (NTP) for Senegal have an estimated value of 7.5 and 1 percent respectively (Kuo, Salci, & Jenkins, 2015). Import duties of 5 percent, 15 percent, and 25 percent are used for primary, intermediate and finished goods respectively.

6.2.2 Commodity-Specific Conversion Factors

Conversion factors are important in that they assist the transition from the financial analysis to the economic analysis. Typically, a conversion factor is the ratio of the economic value to the financial value. To move from the financial analysis to

economic analysis, every line in the financial analysis is multiplied by the corresponding conversion factor. Table 12 shows the summary of the conversion factors used to conduct the economic analysis.

The financial value of tradable items includes distortions such as the import duties and VAT charges, but do not take the Foreign Exchange Premium (FEP). The economic prices of these items are however calculated such that the various distortions are removed, and the FEP factored in. When a conversion factor that is less than 1 is obtained, it means that the financial prices of these items are greater than their economic prices. Items that fall under this category are Pumps, production and distribution meters, fuel, and the inputs used for maintenance of the project.

Another category of inputs used by the project is the non-tradable civil works. Items in this category includes the construction of new boreholes, and water works and networks. These category is made up of both tradable and non-tradable items. The distortions in the tradable items used in the non-tradable civil works arise as a result of the distortions in the tradable materials used in the civil works. Calculating the economic value of these items involves removing these distortions, like import duties and VAT. The economic value of the items in this section also includes the FEP. The distortion in the non-tradable section of the items used in civil works is the VAT. For the non-tradable items, their economic value includes the Premium for Non-Tradable Outlay (SPNTO). A conversion factor less than 1 is obtained for this category of inputs as well, which means their financial prices are greater than the economic prices.

The final category is the labour cost of the project. The major distortions in this category are the income tax, and the difference between the project wages and the alternative wages.

The accounts payable is made up of fuel and maintenance costs. Fuels makes up about 65 percent, and maintenance cost makes up the remaining 35 percent of the accounts payable. The weighted average of the Conversion Factors of these inputs is used as the Conversion Factor (CF) for accounts payable

Financial contributions and grants are not considered to be economic benefits or economic costs, as they are mainly transfers within the economy. Similarly, revenues from existing customers have a conversion factor of zero because the benefits that accrue to as a result of water obtained without the project have been accounted for by the reduction in coping costs.

Table 12: Summary of the Conversion Factors

Item	**Conversion Factor**
Pumps	0.729
Production and distribution meters	0.729
New boreholes, water works and networks	0.859
Household connections and latrines construction	0.859
Fuel	0.729
Labor costs	0.769
Maintenance costs	0.729
Change in accounts payable	0.850
Change in accounts receivable	1.000
Change in cash balances	1.000
Financial Contributions	0.000

Revenues from sales to existing customers	0.000

6.3 Economic Benefits of the Project

As described earlier, the project has three major components. The water infrastructure, sanitation infrastructure and the unified framework intervention. The water infrastructure looks to increase and improve the nature of access to water by making sure that users who erstwhile did not have a reasonable access to water, now do. Furthermore, the project increases the volume of water available to all users in every category. The sanitation component of the project is concerned with improving the sanitation system of the selected areas of intervention. The Third component is mainly concerned with improving the framework already set in place for the two water and sanitation sector of rural Senegal. The following sections discuss the economic benefits of this project.

6.3.1 Direct Benefits

The direct benefits of this project consists of the reduction in coping cost of obtaining water available to consumers without the project, economic value of new water supply, and improved sanitation.

6.3.1.1 Reduction in Coping Costs

World Health Organization and WEDC issued a technical note in 2011, that a minimum of 7.5-15 liters/person/day is recommended for basic survival of people in emergency situations such as camps for displaced population. The disease burden of poor access to water and sanitation services is declining all around the world, as such the non-health benefits of improved water and sanitation services is expected to become more important in sector funding and investment analyses (Cook, Kimuyu, & Whittington, 2016). Therefore, estimation of coping costs of obtaining water for people who do not have household connection in this study focuses on the average amount of time it takes them to fetch the water into their houses. This includes the travel time and the time spent waiting for their turns at the stand pipe. In their study, Cook et al (2016) found that households incur between two to three hours to obtain water from stand pipe/posts in rural Kenya. However, WHO and UNICEF recommends that sources of water should be close enough such that a round-trip collection trip, including queuing should take no more than thirty minutes (WHO and UNICEF , 2015).

Following a survey carried out by AfDB, the coping costs of households were discovered to vary, depending on the nature of the medium of access to water. Households that had access to water prior the project through household connection were rationed to 20 liters/person/day. As a result, the households had to incur storage

and pumping costs. Although they paid no fee to obtain the water, it estimated that they incurred coping costs of approximately 350 XOF/m^3 to be able to consume the amount of 20 liters/person/day. Households with access to water through stand pipe/post incur a coping cost[4] of about 450 XOF/m^3 to obtain 15 liters/person/day. Finally, households with other unreasonable access to water incur a coping cost of about XOF500/m^3.

The graphs presented in Figures 2, 3 and 4 illustrate the economic valuation of the new water supplied to different categories of users.

Figure 2 represents the economic valuation of new water supplied to stand pipe/post users. OC_0HQ_0 shows the daily coping cost incurred by users without the project. With the project, beneficiaries now incur (C_1) to be able to access the water which is supplied to them. This includes a tariff of 200 XOF/m^3. As such, consumers increase the water consumption from 15 liters/day (Q_0) to 30 liters/day. That is an increase in per capita water consumption by 15 liters/day[5].

[4] The estimation of coping costs is done based on the time it takes to obtain water, the value of the time, and the volume of water obtained.

[5] In case of communication, in Figures 3, 4, and 5 the price of water is quoted in units of cubic meters, the volume of water demanded is expressed in the units of liters/person/day. In the financial and economic models, all prices are quoted as the prices per cubic meter and the volume of water sold and consumed is also quoted in cubic meters.

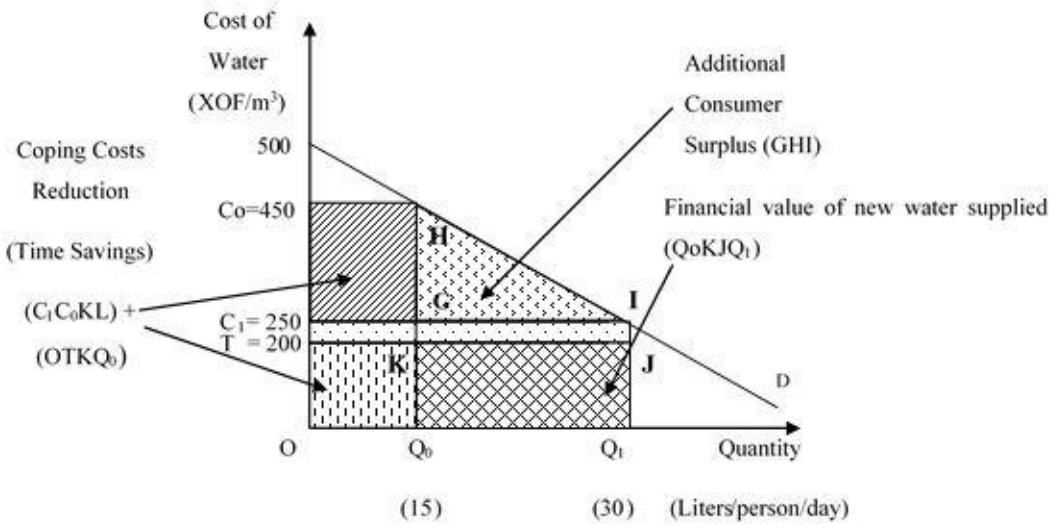


Figure 2: Economic Value of Additional Water Supply for Stand Pipe/Post Users.

The reduction in coping costs as a result of the program is shown by areas C_1C_0HGL plus $OTKQ_0$ as seen in Figure 3 above. The difference between the coping costs of 450 XOF/m^3 without the project and the coping costs of 50 XOF/m^3 (C_1-T) with the project represents the coping cost reduction which is part of the economic benefit generated by the project.

Figure 3 shows the reduction in coping costs for household connection users. With the project, the household connection users do not have any extra coping cost. Therefore, the coping cost savings for them is 350 XOF/m^3.

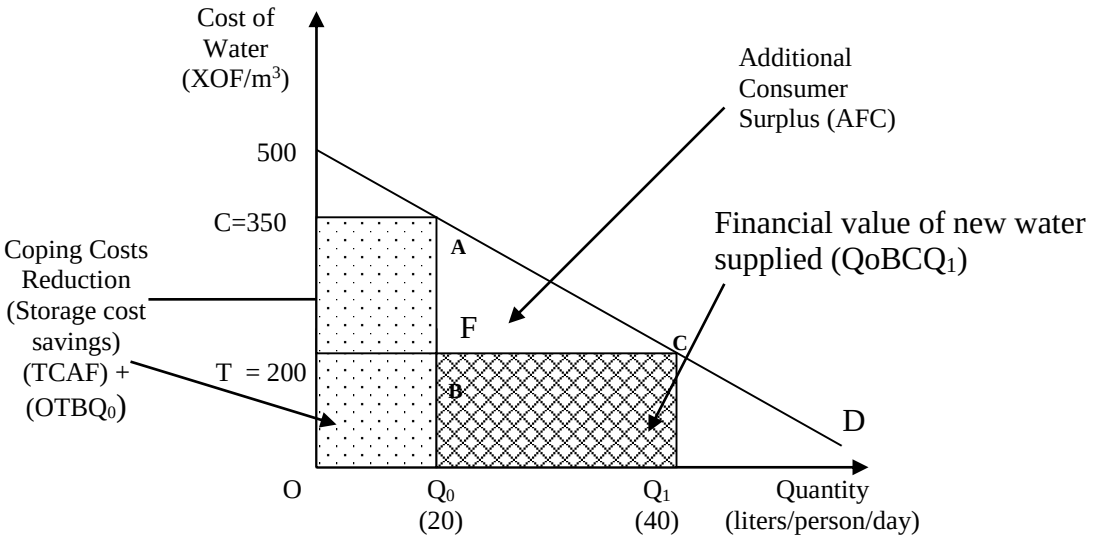


Figure 3: Economic Value of Additional Water Supply for Household Connection Users

Figure 4, illustrates the category of users who before the project had no formal source of water. The water consumed from these sources was obtained by fetching the water from a distance. Hence, there will be a saving cost when these people now obtain water from stand pipe/posts. The water supplied by the stand pipes replaces the 10 liters/person/day of water previously obtained by fetching it from a distance. The coping cost savings as a result of the elimination of the need to obtain water from a distance is shown in figure 5 as $C^{new}C^{old}RV + O^{p}TXQ$

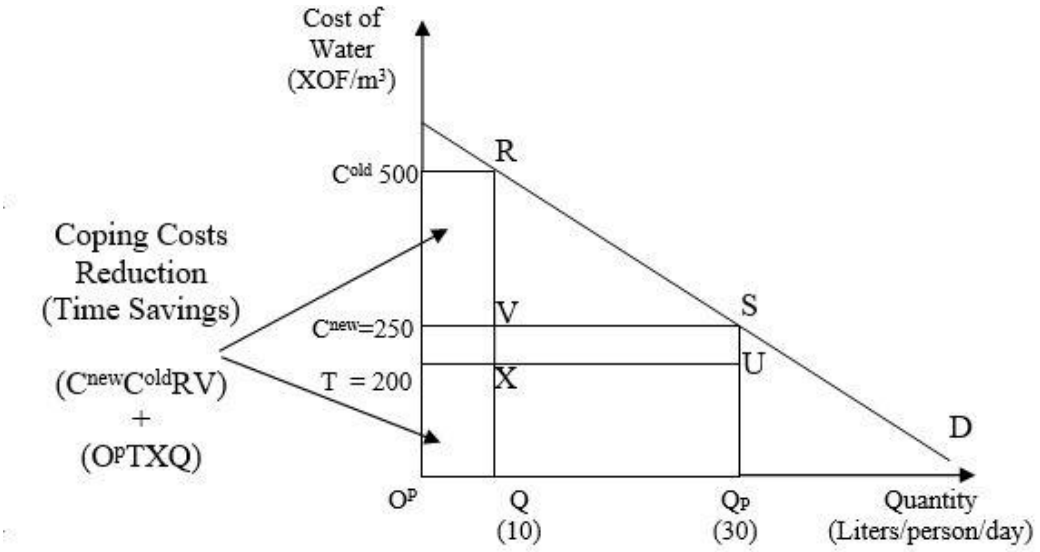


Figure 4: Value of Additional Water Supply for Other Access Users

6.3.1.2 Economic Value of Additional Water Supply

Users who had access to water through stand pipes prior to the project were restricted to 15 liters/person/day. With the implementation of the project, the increased supply of water will allow them to purchase as much as they would want at a price of 200 XOF/m^3 plus their own coping cost of carrying the water from the stand pipe. This cost is estimated to be 50 XOF/m^3. At this cost, it is estimated that they will purchase 30 liters/person/day. The economic value of this additional water consumed is depicted in Figure 2 as the area Q_0HIQ_1 minus the remaining coping costs of KGIJ represents the economic value of new water supplied to users in this category. The tariff of 200 XOF/m^3 is a transfer of some of the benefits obtained by the consumers to the ASUFOR. Therefore, the economic value of the incremental water supply can be simply expressed in Figure 2 as the financial tariff paid of Q_0KJQ_1 for this additional water, plus the gain in consumer surplus[6] seen in GHI.

[6] Consumer surplus is the difference between the price consumers are willing to pay for a good or service, and what they actually pay

Similarly, users who prior to the project had no formal access to water could only fetch 10 liters/person/day. With the project however, they now have access to water through stand pipe/post, and can buy as much water as they want at a rate of 200 XOF/m^3. The willingness to pay for the additional water supply is measured as the area under the demand curve of $QRSQ^p$. However, some time is required to obtain the water from the stand pipe. This coping cost is denoted as $TC^{new}SU$. At this cost they were able to obtain 30 liters/person/day as well. The value of the additional water is therefore the area $QRSQ^p$ minus XVSU, which consists of the additional consumer surplus and the value of the tariff paid for the additional water consumption as seen Figure 4.

The economic benefit of additional water consumption is the financial tariff paid, $QBCQ^1$ plus the gain in consumer surplus FAC as shown in Figure 3.

6.3.1.3 Improved Sanitation

The willingness to pay for improved sanitation depend on the condition of the existing sanitation in the household and the household income. There have been several discussions and debates over the measurement of the willingness of households to pay for sanitation. In developing countries, 2-3 percent of the income of low and middle income households is spent on sanitation. Nonetheless, due to the their meagre income the poorest households are able to spend very little on sanitation, they end up spending most of their income on food (Cairncross, 1992). This study uses the willingness to pay for new sanitation to quantify the benefits that accrue directly as a result of improved sanitation. For this, 2 percent of household income on a monthly basis is assumed to be the willingness to pay for sanitation. This results in about XOF 1,000 per household (Mihelcic, 2005). Hence, all the households benefiting from the program are assumed to value the service at the same rate

6.3.2 Indirect Benefits

The indirect benefits are benefits that can be derived from improvement in other sectors aside the water and sanitation sector, but however enjoyed by the consumers and the economy as a whole as a result of the project.

6.3.2.1 Educational Benefits

Without the project, users had to spend quite some time looking for and fetching water for their daily needs, especially users without any reasonable access. This means that they do not have time to spend in school. With the project however, the time spent on looking for water and fetching it reduces significantly, thus freeing up time for education. Furthermore, improved education implies reduction in time spent on sick beds which can now be spent on education. According to the ministry of Education in Senegal, about 75 percent of children who are able to go to school in the country are enrolled in school on the average in 2003. And the rate of repetition was at 15 percent for all the children who are enrolled. With the program however, the repetition rate is expected to reduce by about 10 percent (conservatively)[7]. This means that less children will have to repeat a class, and as such less money will be spent to repeating students. This has a direct effect on the budget for education in Senegal. It costs 100,000 XOF[8] to train a pupil in a year.

6.3.2.2 Health Impact

Studies have shown over time, that there is a significant relationship between healthy living and water and sanitation systems (Hutton, Haller, & Water, 2004). An estimated reduction in diarrheal infections from 30 percent to 15 percent is expected in households with proper sanitation systems compared with households without

[7] Interviews suggest a higher reduction repetition rates due to improved water and sanitation access.

[8] This is obtained by dividing the education budget by number of enrolled students.

adequate sanitation facilities (Esrey, Potash, Roberts, & Shiff, 1991). Therefore, it is normal to expect a reduction in diarrheal infections as a result of the project. It therefore means that resources will be saved in the health sector, as fewer people will need medical attention

For this analysis, 90 percent of all infections issues are deemed not to require hospitalization. And, the cost of such treatment is 3,500 XOF per sick person. Albeit in the few cases that require hospitalization, the cost per individual is 50,000 XOF (Baltussen, et al., 2003).

It should be noted that income elasticity of demand for water should be considered in the economic analysis of a typical water project. However, the income elasticity in under-developed and rural areas is usually very low (Nauges & Whittington, 2009). Since the project is done in a rural area, the income elasticity of demand for water is also assumed to be zero.

6.4 Results of Economic Analysis.

The results of the economic analysis are presented in this section. The Table 13 shows the results of the economic analysis, with an ENPV of 15,770.8 million XOF and an Economic Internal Rate of return of about 26 percent. These figures show that the water and sanitation project makes the country (society) as a whole better off.

Table 13: Results of Economic Analysis

EOCK	12.00%	*%*
ENPV	**15,770.8**	*Mil XOF*
EIRR	**26.25%**	*%*

Table 14, presents the summary of the economic benefit and costs generated as a result of the project.

Table 14: Economic Resource Flow Statement (In Million XOF)

ECONOMIC BENEFITS	CF	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Revenues from sales to existing consumers	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total economic value of new water supplied		-	880	1,695	2,510	2,510	2,510	2,510	2,510	2,510	2,510	2,510	2,510	2,510	2,510	2,510	2,510	2,510	-
Change in account receivable	1.00	-	(51)	(17)	(21)	-	-	(5)	-	-	(5)	-	-	(5)	-	-	(5)	-	83
Household willingness to pay for new sanitation		-	214	214	214	214	214	214	214	214	214	214	214	214	214	214	214	214	-
Total value of cost savings		-	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534	2,534	-
Value of maintenance cost savings		-	98	96	94	92	91	89	87	85	84	82	80	79	77	76	74	73	-
Total health care savings, real		-	(243)	(47)	149	149	149	149	149	149	149	149	149	149	149	149	149	149	-
Total education budget savings, real		-	537	537	537	537	537	537	537	537	537	537	537	537	537	537	537	537	-
Residual value, household connections and domestic la	0.859	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,296
Residual value, public latrines	0.859	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	687
Residual value, Pumps	1.075	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Residual value, meters	1.075	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	36
Residual value, boreholes water works and networks	0.859	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,041
Contribution by Beneficiaries	0.000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Government contribution	0.000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AfDB grant	0.000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Economic Benefits		-	**3,970**	**5,013**	**6,017**	**6,036**	**6,034**	**6,027**	**6,031**	**6,029**	**6,022**	**6,026**	**6,024**	**6,017**	**6,021**	**6,019**	**6,013**	**6,016**	**5,144**
ECONOMIC COSTS																			
Cost of pumps	1.075	1,129	-	-	-	-	-	1,129	-	-	-	-	-	1,129	-	-	-	-	-
Cost of production & distribution meters	1.075	54	-	-	-	54	-	-	-	54	-	-	-	54	-	-	-	54	-
Cost of boreholes	0.859	687	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cost of water works and networks	0.859	4,983	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cost of household connections	0.859	1,916	-	-	-	-	-	-	-	-	-	-	1,916	-	-	-	-	-	-
Cost of domestic sanitation systems	0.859	3,825	-	-	-	-	-	-	-	-	-	-	3,825	-	-	-	-	-	-
Cost of gathering points	0.859	1,718	-	-	-	-	-	-	-	-	-	-	1,718	-	-	-	-	-	-
Cost of unified framework of intervention	0.769	2,898	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fuel cost	0.729	-	329	438	548	548	548	548	548	548	548	548	548	548	548	548	548	548	-
Total labor cost	0.769	-	26	42	70	71	72	72	73	74	75	75	76	77	78	78	79	80	-
Maintenance cost	1.075	-	16	26	43	43	43	43	43	43	43	43	43	43	43	43	43	43	-
Change in account payable	0.850	-	(19)	(7)	(7)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	31
Change in cash balance	1.000	-	34	11	14	-	-	3	-	-	3	-	-	3	-	-	3	-	(56)
Total Economic Costs		**17,209**	**385**	**510**	**668**	**715**	**662**	**1,795**	**663**	**718**	**668**	**665**	**8,125**	**1,853**	**668**	**669**	**673**	**724**	**(24)**
Net Cash Flow		**(17,209)**	**3,584**	**4,503**	**5,348**	**5,321**	**5,372**	**4,233**	**5,367**	**5,311**	**5,354**	**5,360**	**(2,101)**	**4,165**	**5,353**	**5,351**	**5,340**	**5,293**	**5,168**

6.5 Economic Sensitivity Analysis

As was the case with the financial analysis, parameters deemed to have potential impact on the project's outcome on the well-being of the society, are tested. This section describes the results of these tests.

6.5.1 Real Price of Fuel Oil

Table 15 shows how sensitive the economic feasibility of the project is to a change in real price of fuel oil per liter. A 10 percent reduction in the fuel price per liter brings about a change in the ENPV from a base case of 15,771 to 16,122 million XOF. However, an increase in fuel price per liter by 10 percent brings the ENPV down to 15,420 million XOF.

Table 15: Fuel cost

CHANGE IN FUEL COST	ENPV (Million XOF)
BASE CASE	15,771
-10%	16,122
-5%	15,946
0%	**15,771**
5%	15,595
10%	15,420
15%	15,244
20%	15,069
25%	14,893
30%	14,718
35%	14,542
40%	14,366

6.5.2 Water Availability Factor

As seen in Table 16, a decrease in the water availability factor from 100 percent to 80 percent decreases the ENPV to 10,851 million XOF. The ENPV however increases to 18,231 million XOF if the water availability is at 110 percent.

Table 16: Water Availability Factor

WATER AVAILABILITY FACTOR	ENPV (Million XOF)
BASE CASE	15,771
50.00%	3,470
60.00%	5,930
70.00%	8,391
80.00%	10,851
90.00%	13,311
100.00%	**15,771**
110.00%	18,231

6.5.3 Investment Cost Overrun

Table 17 shows that a decrease in the investment cost by 5 percent increases the ENPV by about 6 percent. Similarly, a 10 percent increase in the investment costs reduces the ENPV by about 12 percent.

Table 17: Investment Cost Overrun

INVESTMENT COST OVERRUN	ENPV (Million XOF)
BASE CASE	15,771
-10%	17,726
-5%	16,749
0.00%	**15,771**
5%	14,793
10%	13,815
15%	12,837
20%	11,860
25%	10,882

6.5.4 Coping Cost Savings

Table 18 shows that a reduction in the initial coping cost savings for stand pipe/post users from a base case of 400 to 300 XOF/m^3 reduces the ENPV by about 5 percent. Whereas if the coping cost for stand pipe/post users without the project was 600 XOF/m^3, the ENPV increases by about 5 percent.

Table 18: Coping Costs Savings

COPING COST/m^3	**ENPV (Million XOF)**
BASE CASE	15,771
100	13,365
200	14,167
300	14,969
400	**15,771**
500	16,573
600	17,375
700	18,177
800	18,979

6.5.5 Cost of Treatment per Visit

As seen in Table 19, a 75 percent decrease in the unit cost of treatment per visit from the base case of 3,500 XOF per visit brings about a 0.5 percent decrease in the ENPV.

Table 19: Cost of Treatment per Visit

COST OF TREATMENT PER VISIT (XOF)	ENPV (Million XOF)
BASE CASE	15,771
2,000	15,682
3,500	**15,771**
5,000	15,859
7,500	16,007
10,000	16,155

6.5.6 Unit Cost of Treatment per Day

If the unit cost of treatment per day[9] changes from the base case of 50,000 to 30,000 XOF per day, the ENPV reduces by about 0.8 percent. If it however increases to 90,000 per day, the ENPV increases by approximately 1.6 percent as seen in Table 20.

Table 20: Cost of Treatment per Day

COST OF TREATMENT PER DAY (XOF)	ENPV (Million XOF)
BASE CASE	15,771
30,000	15,640
50,000	**15,771**
70,000	15,902
90,000	16,033

6.5.7 Reduction in Rate of Repetition

The project is expected to bring about a 10 percent reduction in repeaters rate. Table 21 however shows that if the project fails to bring about a reduction in repeaters rate, the ENPV reduces by about 24 percent. And the education no longer benefits from

[9] Note that the cost of treatment per day is relevant to hospitalized cases, and the cost of treatment per visit is for patients who do not require hospitalization

the project. If, however, the project is able to bring about a 15 percent reduction in the repeaters rate, the ENPV increases by about 12 percent. This also reflects in the benefits that accrue to the education sector.

Table 21: Reduction in Repetition Rate

REDUCTION IN REPETITION RATE	**ENPV (Million XOF)**
BASE CASE	15,771
0.00%	12,024
10.00%	**15,771**
15.00%	17,644
20.00%	19,517
30.00%	23,264
40.00%	27,011

6.6 Conclusion of Economic Analysis

The economic analysis of the water and sanitation project shows that the society is made better off as a result of the project, with a positive ENPV of approximately 15,571 million XOF. Furthermore, as seen from the results of the sensitivity analysis presented above, the most important factor is the water availability factor. A change in this factor affects the ENPV significantly. More about how this uncertainty can be managed is described in Chapter 8, which deals with the Risk Analysis section of this study.

Chapter 7

STAKEHOLDER ANALYSIS

7.1 Introduction to Stakeholder Analysis

This chapter turns to another integral part of the IIA approach. Stakeholders are people who are directly affected by the outcome of the project, and can as well affect the outcome of the project. This section of the analysis therefore seeks to determine the losers and gainers of the project, and the extent of the loss or gain. It typically draws from the financial and economic analyses described in the previous chapters.

Also known as distributional analysis, the stakeholder analysis seeks to analyze how every stakeholder involved in the project are affected by it. Sustainability of the program will be hardly possible if stakeholders who are better off or worse off as a result of the project are not recognized, and the extent to which this happens determined.

Stakeholder analysis is made possible from the fact that the economic price of an item is the sum of the financial price and all the externalities the item generates. As such the Economic Net Present Value (ENPV) of the item is the sum of the Present Value (PV) of the financial price of the item and the Present Value of all the Externalities generated by the item, if the same discount rate is used to estimate the Present Values.

$$NPV_{Economic} = NPV_{financial} + PV(\sum Externalities)$$

Table 22 shows the reconciliation of the financial, externalities and the economic impacts of the project. The first column shows the financial outcome, the second column represents the externalities and the third one shows the economic outcomes, which based on the relationship described above must be equal to the fourth column which sums up the financial and externality outcomes.

Table 22: Reconciliation of Financial, Economic, and Stakeholders Statement (Million XOF)

Benefits	**Financial**	**Externality**	**Economic**	**Financial + Externality**
Revenue from sales to existing customers	8,848	(8,848)	-	-
Economic value of new water supplied	10,734	4,664	15,398	15,398
Change in accounts receivable	(68)	-	(68)	(68)
Household willingness to pay for new sanitation		1,490	1,490	1,490
Total value of cost savings		17,671	17,671	17,671
Value of maintenance cost savings		619	619	619
Health sector savings		535	535	535
Savings in Cost of Education		3,747	3,747	3,747
Residual value, household connections and domestic latrines		334	334	334
Residual value, public latrines		100	100	100
Residual value, Pumps	-	-	-	-
Residual value, meters	5	0.36	5.2	5.2
Residual value, boreholes water works and networks	346	(49)	297	297
Payment from Beneficiaries	2,131	(2,131)	-	-
Total investment Cost Paid AfDB Grant	17,500	(17,500)	-	-
Government Contribution	2,775	(2,775)	-	-
Total Economic Benefits	42,271	(2,143)	40,128	40,128

COSTS				
Pumps	1,851	139	1,990	1,990
Production and distribution meters	123	9	132	132
New boreholes	800	(113)	687	687
Water works and networks	5,800	(817)	4,983	4,983
Household connections	2,871	(405)	2,466	2,466
Domestic latrines	5,732	(808)	4,924	4,924
Public latrines	2,575	(363)	2,212	2,212
Unified framework	3,770	(872)	2,898	2,898
Input purchases	4,852	(1,316)	3,537	3,537
Labor costs	580	(134)	446	446
Maintenance costs	244	18	262	262
Change in Accounts Payable	(30)	5	(26)	(26)
Change in Cash Balance	46	-	46	46
Total Economic Costs	29,214	(4,657)	24,558	24,558
Net Externalities Flow	13,057	2,514	15,570	15,570

Table 23 shows the distributive analysis of the externalities generated by the project. It shows the stakeholders who lose and gain, and the extent to which this happens, as a result of the project. The net externalities flow represents the sum of all the negative and positive impacts of the project on all the stakeholders involved in the project.

Users of the water and sanitation project (Consumers) have a net benefit of about 13,235 million XOF. These externalities are generated mainly from the economic value of the new water supplied, the coping cost savings, the improved sanitation, the residual value of household connections and domestic latrines which they paid for in the investment period. The only cost that the users incur is the contribution made by

beneficiaries to the investment cost, the periodic replacements of house connections and domestic latrines, and the payment of water tariff.

Labour has a positive net benefit of 715 million XOF. This is generated majorly from the fact that the ASUFOR pays the labour it employs more than they would have gained from doing the same job elsewhere.

The project brings about a positive externality to the Government[10]. A positive value of 1,783 million XOF accrues to the government as a result of the project. The benefits to the government accrues from the several tax obligations of the materials used by the project, the income tax levied on labour, and the residual values of the items which the government is responsible for replacements in due time. The costs that accrue to the government come from the contribution made by the government to the investment cost.

The health sector benefits from the project because it is able to save some of the costs it otherwise would have incurred by treating the diseases that were eradicated as a result of the project. This amounts to 535 million XOF

Similar to the health sector, a positive value of 3,747 million XOF was accrued to the education sector as it is able to save some funds as a result of reduction in repetition of pupils.

[10] This refers to the other sectors that are not specifically mentioned.

It must be noted that the grant given by AfDB for this project could have been used for other projects, that would have yielded benefits to the economy at least equal to the value of the grant.

Table 23: Distributive Analysis (Million XOF)

Benefits	**Externalities**	**Consumers**	**Labor**	**Government**	**Health Sector**	**Education Sector**	**Others**
Revenue from sales to existing customers	(8,848)	(8,848)			(8,848)	(8,848)	
Economic value of new water supplied	4,864	4,864			4,664	4,664	
Household willingness to pay for new sanitation	1,490	1,490			1,490	1,490	
Total value of cost savings	17,671	17,671			17,671	17,671	
Value of maintenance cost savings	619			619	619		
Health sector savings	535				535		535
Savings in Cost of Education	3,747					3,747	3,747
Residual value, household connections and domestic latrines	334	389		(55)			
Residual value, public latrines	100			100			
Residual value, Pumps	-			-			
Residual value, meters	0			0			
Residual value, boreholes water works and networks	(49)			(49)			

Payment By Beneficiaries	(2,131)	(2,131)					
AfDB Grant	(17,500)						(17,500)
Government Contribution	(2,775)			(2,775)			
Total Benefits	**(2,143)**	**13,435**	**-**	**(2,159)**	**535**	**3,747**	**(17,500)**
COSTS							
Pumps	139			139			
Production and distribution meters	9			9			
New boreholes	(113)			(113)			
Water works and networks	(817)			(817)			
Household connections	(405)			(405)			
Domestic latrines	(808)			(808)			
Public latrines	(363)			(363)			
Unified framework	(872)		(619)	(253)			
Input purchases	(1,316)			(1,316)			
Labor costs	(134)		(95)	(39)			
Maintenance costs	18			18			
Change in Accounts Payable	5			5			
Change in Cash Balance	-			-			
Total Economic Costs	**(4,657)**	**-**	**(715)**	**(3,942)**	**-**	**-**	**-**
Net Externalities Flow	**2,514**	**13,435**	**715**	**1,783**	**535**	**3,747**	**(17,500)**

In summary, the consumers are the highest gainers from the project with a positive net externality value of 13, 435 million XOF, and the losers are other projects that cannot

be funded as a result of the funds used up by this water and sanitation project. It must be noted that although the Net benefit to ASUFORs are considered as the FNPV in this analysis, since they are part of the society (economy) and it is not as though the benefits that accrue to them are shipped elsewhere, the FNPV of the ASUFORs is also part of the benefits that accrue to the society, as a result of the project. Table 24 summarizes the net benefit of this project to the major stakeholders.

Table 24: Summary of Net Benefits to Major Stakeholders

Stakeholder	Net Benefit (Million XOF)
ASUFORs	13,057
Consumers	13,435
Labour	715
Government	1,783
Health sector	535
Education Sector	3,747

Chapter 8

RISK ANALYSIS

8.1 Introduction to Risk Analysis

Risk analysis is one of the major pillars of the IIA approach of analyzing projects. The major drawback of the deterministic analysis discussed so far is the implicit assumption that the values used for the project variables are known with a 100% certainty, and as such the results obtained are 100% certain. However, since the project continues into the future, it would be counterintuitive to expect that there won't be changes in the variables used in the project, in the real world, and the results obtained. Therefore, a risk analysis is performed to analyze the variations that can be obtained in the financial and economic outcomes of the project.

8.2 Risk Simulation

The method approach employed to analyze the risks of this project is such that the uncertainties that are associated with the critical variables of the project are expressed in terms of probability distributions. Monte Carlo simulations is one of the most practical ways of getting an approximate value for the dynamics and uncertainties inherent in the variables used in the analysis, as expected in the real world. The analysis repeats the simulation of the financial and economic analyses ten thousand (10,000) times using the distributions for the values of the most sensitive and uncertain variables. Thus, allowing for a statistical analysis of the simulations and as such obtaining a distribution of possible outcomes of the project and the probabilities of their occurrence.

The sensitivity analyses done in the financial and economic analyses discussed in previous chapters indicate that a change in the key parameters can potentially lead to a significant difference in the outcome of the project. However, in the sensitivity analysis, only one of the variables are changed at a time, the risk simulation however allows changing multiple variables at the same time, thus seeing their combined effect on the outcomes of the project. In addition, the sensitivity analysis does not include the likelihood of occurrences as obtained in the risk analysis. However, the sensitivity analysis brings to fore, the variables that have the most effect on the project outcomes, these variables are the ones used in the risk analysis.

As obtained from the sensitivity analysis, the major variables that have the most significant effects on the project outcomes are tested. These variables and their impacts are described below.

- **Investment cost overrun**: This directly impacts the investment costs, and has a significant effect on both financial and economic outcomes of the project. A number of factors are generally responsible for investment cost overruns. These include but are not limited to inadequate project formulation, poor planning for implementation, lack of proper contract planning and management, and lack of project management during execution (Chitkara, 2009). Therefore, the management should be able to control this to a large extent. More on ways of mitigating the risks is discussed in proceeding sections

- **Water Quantity availability**: This can be due to a number of factor, ranging from population density, to mechanical problems. This has a direct effect in the financial sustainability of the project, and the ability of the ASUFOR to cover

the replacement cost. Whereas, the mechanical problems can be controlled to a large extent, there is nothing that can be done about the population density.

- **Real price of fuel oil**: Fuel prices are not set domestically, as such is completely out of the hand of the management. Fluctuations in the real prices of fuel oil is significant as it makes up a huge chunk of the ASUFORS' operating costs and as such affects the financial outcome of the project.

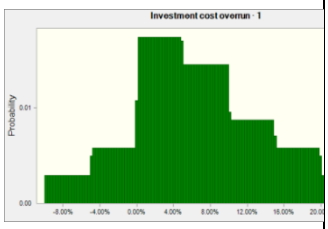
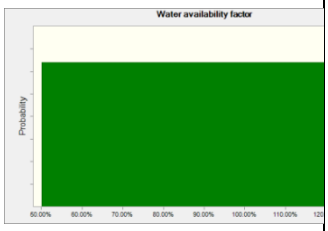
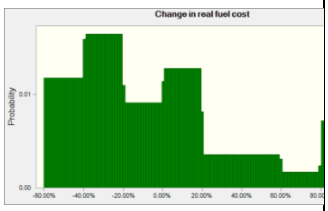
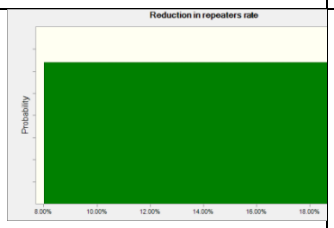
- **Reduction in repeaters rate**: This variable has a direct impact on the education sector, and by extension the economic viability of the project. The rate was obtained from interviews, thus the need for it to be tested as there is no way to verify the authenticity of the interviewees.

Once the risky variables have been identified, the next stage of the risk analysis is to select an appropriate probability distribution for the variables, and a likely range of variables. This is usually based on historical data on the variables, or an expert opinion.

8.3 Results of Risk Analysis

A Monte-Carlo simulation which involves 10,000 trials was conducted, using the risk variables identified from the sensitivity analysis. The possible range of values for the risky variables and their respective probability distributions are shown in Table 25.

Table 25: Probability Distribution for Selected Risky Variables

Variable	Distribution Type		Range and Parameters
Investment Cost Overrun	Custom Distribution		Minimum / Maximum / Probability -10.00% / -5.00% / 0.05 -5.00% / 0.00% / 0.10 0.00% / 5.00% / 0.30 5.00% / 10.00% / 0.25 10.00% / 15.00% / 0.15 15.00% / 20.00% / 0.10 20.00% / 25.00% / 0.05
Water Availability Factor	Uniform Distribution Mean: 90% Base Case Value:100%		Minimum 50.00% Maximum 130.00%
Real Change in Fuel Oil Price	Custom Distribution		Minimum / Maximum / Probability -60.00% / -40.00% / 0.18 -40.00% / -20.00% / 0.25 -20.00% / 0.00% / 0.14 0.00% / 20.00% / 0.19 20.00% / 40.00% / 0.05 40.00% / 60.00% / 0.05 60.00% / 80.00% / 0.03 80.00% / 100.00% / 0.11
Reduction in Repeaters Rate	Uniform Distribution		Minimum 8.00% Maximum 20.00%

8.3.1 Financial Outcome

The frequency distribution of the financial outcomes of the project from the ASUFORs perspective is presented in Figure 7. The base case as obtained from the financial analysis is 13,056.54 million XOF. Figure 6 however shows that given the risky variables and the assumptions used to conduct the risk analysis, the expected value is

10,584.22 million XOF. This expected value represents the average value of the FNPV obtained from 10,000 simulation trials. In line with this analysis, the lowest NPV of all ASUFORs is (156.93) and the maximum value is 21,573.31 million XOF, and the standard deviation is 3,629.24 million XOF. And the probability of obtaining an FNPV that is less than zero is 0.03%

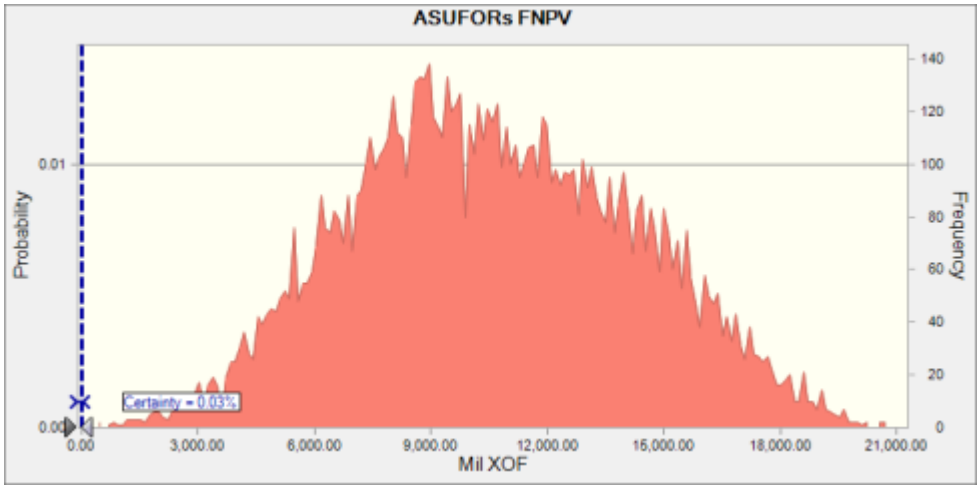


Figure 5: Probability Distribution of Financial Outcomes

8.3.2 Economic Outcome

In regards to the economic results, the base case ENPV as obtained in the analysis is 15, 770.8 million XOF. However, the average of the ENPVs obtained after 10,000 simulations is 13,148 million XOF. The simulations yielded ENPVs ranging from (931.6) to 26,547.9 million XOF, with a standard deviation of 5,021.7 million. The probability of obtaining an ENPV that is less than zero, in which case the project will be bad for the economy as a whole is 0.04%. Figure 7 shows the probability distribution of the economic outcomes of the proposed project.

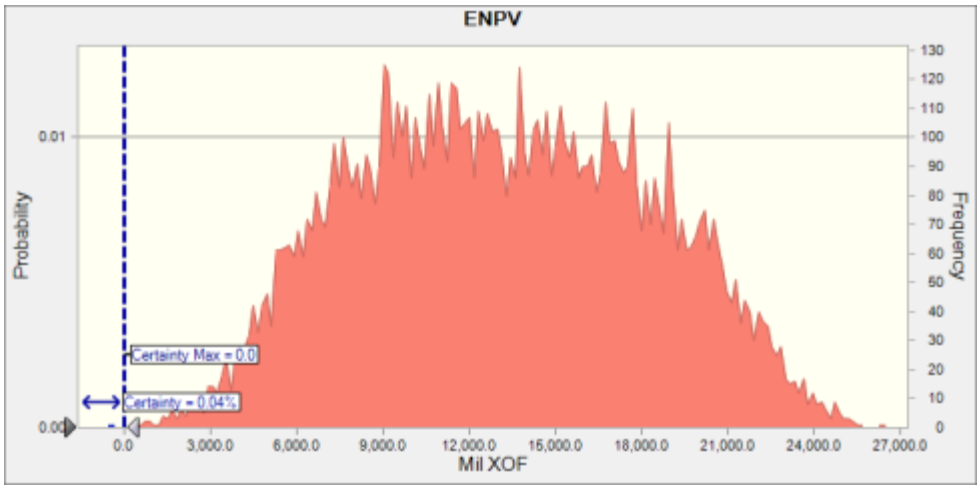


Figure 6: Probability Distribution of Economic Outcomes

8.3.3 Stakeholder Impacts

The risk analysis shows that the consumers will always have a positive net impact with a mean value after 10,000 simulations of 12,643 million XOF and a standard deviation of 1,657 million. Similarly, the education and health sectors will always have a positive net impact, with expected values of 4,317 and 17 million XOF respectively, and standard deviations of 763 and 121 million respectively. This is because the only time the project will make this sectors lose is when it reduces the number of people with access to water, and even at the worst possible case of water availability of 50%, more people have access to water as a result of the project.

The risk analysis shows that on a holistic scale, the project is such that will benefit every major stakeholder. As seen from the results, the probability of incurring a loss from the perspective of everyone involved is quite low.

Selected statistics on stakeholders' externalities resulting from the risk simulations are shown in Table 26 below.

Table 26: Summary of Stakeholders Externalities Statistics (Million XOF)

	Consumers	**Government**	**Health**	**Education**
Deterministic Value	13,436	1,783	535	3,747
Mean	12,643	1,812	534	4,317
Median	12,637	1,676	532	4,319
Standard Deviation	1,657	613	62	763
Minimum	9,495	664	428	2,998
Maximum	15,689	4,168	642	5,620
Probability < 0	0.00%	0.01%	0.00%	0.00%

Chapter 9

CONCLUSION

Considered as a human right, water and sanitation are essential for human survival. Without adequate water and sanitation systems, the very existence of humans is put under serious threat. Sadly, the water and sanitation system especially in the rural parts of Senegal barely meets up with the minimum requirements for safe and healthy livelihood of its inhabitants. In accordance to its MDG development goals, and government of Senegal with support from the African Development Bank (AfDB) chose to embark on a water and sanitation project in selected areas of rural Senegal.

The program is structured such that the ASUFORs are responsible for the maintenance, operation and a small part of the investment costs of the project. Thus, the analysis of this project started with assessing the financial feasibility of the project. This shed light on the ability of the project to generate enough cashflow for its operation and maintenance. The results of this analysis using the NPV criterion shows that the project does in fact generate enough cash flow for its operation and maintenance with a FNPV of 13, 056.54 million XOF.

The analysis then proceeds to assess the impact of the project on the economy as a whole. The financial prices used in this analysis were converted into their economic prices by using the corresponding conversion factors. The conversion factors are used to remove the distortions in the financial prices, and to account for the FEP, and the

NTP generated by the items, thus, bringing to fore the true economic values of these items. To get the economic value of the water infrastructure, the economic value of the new water supplied was calculated, and the reduction in coping cost of water initially available to users at a higher coping cost was estimated. The benefits from the sanitation component of the project is divided into direct and indirect benefits. The direct benefit was estimated using the willingness of households to pay for sanitation. The indirect benefits are the health and education cost savings. The economic analysis reveals that the project does make the targeted areas, and the country as a whole better off with a positive ENPV of 15,770.8 million XOF.

The major stakeholders are made better off as a result of the project, with the users of the water and sanitation systems gaining the most from the project. The project significantly reduced the coping costs of obtaining the water available to users prior to the project, and it also increased the volume of water available to each individual in the selected areas. Furthermore, the health and education sectors benefited as a result of the savings that accrue to them due to the project. The government incurs the cost of financing a portion of the investment costs. The government however benefits from the taxes and Foreign Exchange Premium got from the materials used by the project, and the income tax imposed on the labor employed by the project.

The project's outcome is mainly threatened by the local water availability and the investment cost overruns. The investment cost overruns will affect every stakeholder because all the stakeholders have a portion of the investment cost. The financial and economic viability of the project is heavily dependent on water availability as well. A low water availability means that the revenue generated by ASUFORs significantly reduces, and the amount so does the volume of water available to consumers.

The risk analysis however shows that judging from historical data and expert opinions, the risk can be easily mitigated. Some of the causes of investment cost overruns as discussed in the study can be easily mitigated by proper feasibility studies and by signing appropriate contracts that will eliminate or at least reduce the investment cost overrun risk to the very minimum. Similarly, the water availability factor is influenced by two major factors, the population density and possible mechanical faults. The ASUFORs are responsible for the maintenance and operation of the facilities installed by the project, there should therefore be a proper oversight to ensure that the infrastructures are being maintained and operated according to required standards. This will reduce the water availability risk.

The process of determining the water prices and tariffs must however be fair. The government must ensure that a transparent mechanism is put in place so that the ASUFORs do not have an incentive to exploit the users, but are able to properly manage and keep the system in full operation. Again, the ability of the consumers to pay must be considered. This is because even if the infrastructure ensures that water is available, if people cannot pay for it, they will look for other alternatives as unhealthy as they may be. If this happens, the ASUFORs will be unable to generate the needed revenue for maintenance and operation and as the consumers will not reap the benefits of the project, thus making the project a failure from every perspective.

The magnitude of the economic outcome is significantly dependent on the efficient implementation of the project components. Cost overruns and inadequate water availability will reduce the education, health and consumer benefits

There is still some work to be done in the water and sanitation sector of Senegal as a whole. However, this project is a step in the right direction for the country, and can be used as a model which can be used to improve the water and sanitation systems of other areas of the country. This is because the people of the selected areas of intervention are made much better off. Not only do they have better access to water, they also have a significant reduction in issues related to their health which means that they have more time to make ends meet and alleviate their poverty. Furthermore, their children get make progress in their pursuit of a proper education as the project brings about a significant reduction in the rate of repetition of pupils, and as a result frees up funds that could be used to improve the quality of education, funds which erstwhile went to training repeaters. This project puts Senegal on the path of achieving its MDG goals.

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