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Financial Investment Management for Forest Sustainability

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FINANCIAL INVESTMENT MANAGEMENT FOR FOREST SUSTAINABILITY

BY

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This thesis is approved as a creditable and independent investigation by a candidate for the Master of Science in Operations Management degree and is acceptable for meeting the thesis requirements for this degree. Acceptance of this thesis does not imply that the conclusion reached by the candidates are necessarily the conclusions of the major department.

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ABBREVIATIONS

BCA – Benefit -Cost Analysis

BSM – Black-Scholes Model

CBA – Cost-Benefit Analysis

CTF – Conservation Trust Fund

DCF – Discounted Cash flow

EIB- Environmental Impact Bonds

ERR – Economic Rate of Return

FLR – Forest Landscape Restoration

FAO – Food and Agriculture Organization

FMP – Forest Management Plan

GPFLR – Global Partnership on Forest and Landscape Restoration

GEF – Global Environment Faculty

GFRA – Global Forest Resources Assessment

IRR – Internal Rate of Return

IPCC – Intergovernmental Panel on Climate Change

LSM – Least -Squares Method

NGO – Non-Government Organizations

NPV- Net Present Value

PPP- Public-Private Partnership

PFP- Pay for Performance

ROA- Real Option Analysis

RQMC – Randomized Quasi Monte Carlo

SIB – Social Impact Bonds

SFM – Sustainable Forest Management

UNFCCC – United Nations Framework Convention on Climate Change

UNEP – United Nations Environment Program

ABSTRACT

FINANCIAL INVESTMENT MANAGEMENT FOR FOREST SUSTAINABILITY

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This is paper is discussion about main problems of forest management, whether financial investment has a substantial impact on the long term perspective of forest landscape restoration and, more specifically, what strategy and what financial options are available to make the forest projects more sustainable. A few relevant questions to ask are: who are the main actors in the implementation of FLR projects; which steps have to be taken; and, which financial options would more suitable and would be feasible to implement. There are three main parts of this research to be investigated:

1. forest issues along with their respective solutions,
2. financial investment as an operational tool, and
3. financial mechanisms for sustainable forestry.

The description of the global problem of deforestation in the period of the end of the last century and the current time is area of interest, as well as, the influence of the deforestation on the environment and implementation of financial tools to make environmental management more sustainable. The main two subjects or themes that are going to be explored are: the problem of deforestation and the implementation of innovative financial tools to help in solving environmental issues. In recent years, interest

in impact investing has grown substantially. Socially, oriented organizations are pursuing innovative financial solutions that address complex social problems. It requires great collaboration among philanthropists, government, and private investors. Financial investment is a representation of the significant and growing input of capital that can fund programs to address social or environmental problems and get effective sustainable output. While investing in the business, most investors would like to get their financial return in a short period of time. However, this tendency is gradually changing. A growing number of investors want to use their capital to make positive social and environment changes and is becoming a main stream financial approach (Rockefeller Philanthropy Advisors, 2009).

This paper shows the possibility of implementation different types of methods of the real options approach to forestry investment analysis. The main objectives are to discuss the theory of real option and describe methods which can be applicable for uncertainty and managerial flexibility in forest management and investment. In addition, we will use the simulation method as a most flexible method to calculate the option values of timber contracts what could help managers of forest projects to make the proper decision.

One of the main focus in current research paper is to implementation of the methodology which is applicable to value of the scale sale harvest contract. The value of a harvest contract with stochastic timber prices can be considered as expected cash flow as well as discounted profit from the forest yields at the optimal time (Petrasek & Perez-Garcia, 2010).

Chapter 1: Introduction

1.1 Identification of Problems

The forest is one of the main constituents of the human environment. To a large extent, it influences the climate, the availability of clean water, the air quality, the agricultural land characteristics, and the available space for comfortable living and recreation for people, and the ecosystems for a variety of wildlife. The forest is also the source of numerous resources for humankind. It provides material for construction, paper and furniture, food and medicinal uses, and other economic resources. It can also be considered as part of the cultural and historical environment, which is formed under the influence of the culture and customs of entire nations. (Food and Agriculture Organization, 2012). According to the United Nations Food Agriculture Organization, forest products such as wood and manufactured products add more than $450 billion to the world market economy annually, and the annual value of internationally traded forest products is between $150 billion and $200 billion (Köhl, Lasco, Cifuentes, Jonsson, Korhonen, Mundhenk & Stinson, 2015)

1.2 Purpose of the study and Related Questions

With the development of civilization and rapid population growth, the global consumption per capita is increasing as well. As a result, there is more demand for resources. As was reported by United Nations Framework Convention on Climate Change (UNFCCC), over the past decades, there is a significant deforestation and forest degradation especially in developing countries. The growing needs for wood, paper as well as other services increase the pressure on forests (d'Annunzio, Sandker, Finegold & Min, 2015). One of the main tasks of management is increasing the production efficiency with less

waste. But to make any the industry efficient, first of all we need to have available production. The main concentration of current paper is forest (timber) production, forest management and its sustainability. The question which arise in this term is, how can we increase forest production, effectively manage it and at the same time develop the forest sustainability, to make it accessible for the future generation? Implementation of Forest landscape Restoration (FLR) projects requires financial funds, and for a long-term period, due to certain specificity of forestry. The financial investment comes from both public and private sources. Public resources not only provide funding for projects but also strengthens the FLR initiatives. The main contributions of government investment are technical support and a partnership that strengthens the initiatives of FLR. The remaining financial investments come from a large pool of private entities. They include stakeholders, such as insurance companies, national banks, individuals, and micro finance institutions. Private sector actors have a different range of instruments that can vary based on the time period of FLR projects. Public-private partnerships (PPP) is another arrangement that can provide access to additional sources of funding (FAO, 2015).

It is not only a question of accessible finance, but also the development of financial mechanisms that can help to decrease the gap between the theoretical framework and the practical implementation of investment projects. In these cases, each sector has its own role. The private sector can provide investment into projects while the role of the public sector is to attract asset investment and create a national fund. It is also important to note the participation of different stakeholders in the process of development, their relationship, impediments, and opportunities (Warner, 2013).

1.3 Limitation of the Study

When we are talking about investment in conservation we consider the financial input into conservation, which can generate long-term, and diversified sources of revenue for environmental projects. But while making decision about working with certain environmental project or not, financing strategy as well as measurement approaches should be evaluated as more precise as possible. There are different possible methods which can be used to evaluate the investment opportunities. But in order to properly evaluate the investment possibilities for forest projects managers there is necessity to take into account the specificity of forest, that is uncertainty of future cash flows and risk attitudes (Pažek, & Rozman , 2011).

The current paper will consider real options approaches as a possible valuation tool for timber harvest contracts, which can help in making investment decision and getting maximum possible benefit from forest projects.

An option it's a right but not obligation for the holder to sell or buy "a share of stock at a specified price". Two different options such as ''call'' option gives the holder the right to buy a stock, and a ''put'' option gives the holder the right to sell a stock. There are two other specifications, American option and European option. The main difference between them is that American option can be exercised before maturity day and European option inly at maturity day (Yeo & Qiu, 2003).

One of the well-known method applicable for valuation of timber harvest contracts in the presence of stochastic timber prices is Black-Scholes model which is considered to be used for the valuation of European options. But in case of forest projects, American

option provides more managerial flexibility since it condition allows to harvest the forest and exercise the contract based on maximum possible value (Petrasek & Perez-Garcia, 2010). When we are talking about investment valuation related to forest land, usually this characterized by multiple uncertainties and long time frames. In this case, the optimal method which could rational to use will be Simulation methods. One of the well-known and commonly used simulation method which also used for current research paper is Monte-Carlo simulation. The main advantage that Monte Carlo compare to other valuation techniques is ability to work with multiple number of uncertainties (Regan, Bryan, Connor, Meyer, Ostendorf, Zhu & Bao, 2015).

1.4 The Main Outlines of Chapters

This paper was organized in following order. The second chapter is Literature review which provides the structural description of the current work together with revision of the research papers. The chapter three is discussing the main issues of forest related programs as well as questions of the sustainable management with proposal of possible solutions. Chapter four talks about the role of investment in nature conservation projects as well as appropriate financial models which can stimulate the impact of investment into environmental projects. The chapter five is about general management position as well as theoretical framework on background about possible and the applied methodologies. Chapter six presents the example of financial methodology application. The last chapter is conclusion with related specifications which can be utilized as a possible guidance for decision making only.

Chapter 2: Literature Review

2.1 The Investment as Important Notion for Nature Conservation

The financial investment for nature conservation as a concept which got recent recognition on a global scale. It is rather new notion and there is no deep practicable knowledge and no any evaluation criteria for some of its instruments. Especially such important concept like risk and investment returns as well as measurement of impact perspective have not been properly researched yet. Not only investors, but also governments and social businesses are needed in for standardized and transparent measurement metrics for future market development. Right now it is difficult to attract the investors to finance the Environmental projects because there is no exact proper method of measurement of impact and parameters of related risks and returns. Some researches mentioning about necessity to develop the innovative financial approaches for the nature conservation investment (Geobey, Westley & Weber, 2012).

Conservation finance by itself is not very new idea. Many different financial mechanisms were developed and tested before. The discussion about conservation finance was taking place for the more than last 25 years. The most of the concentration of discussion was on what kind of programs and strategies to develop in order to meet financing demand for conservation programs and how to extend them into to broader programs and whole market (Huwyler, Käppeli, Serafimova, Swanson & Tobin, 2014).

2.2 Implementation of Innovative Financial Tools

Most of the time there is not enough investment for conservation projects, because not enough expertise in and knowledge about benefits from conservation programs. There are different financial innovative approaches which were developed recently. One of such approach is Environmental Impact Bonds more known as Social Impact Bonds. This tool is a new financial instrument which governments can use to finance the social as well as conservation projects. It has some advantages as well as disadvantages. It is possible to get the efficiency of the social or conservation programs if the structure and procedures of SIB(EIB) are properly implemented. But there are some issues related to implementation of SIB (EIB) as well. For example, there is not exact way of measurement developed yet and it can make difficult to attract investors due to financial risks of return. In addition, these instruments can cause extra administrative costs and that is why it is better to implement such approach, only if there is expected positive benefits or outcomes from realization of projects (Kohli, Besharov & Costa, 2012).

The purpose of implementation of SIB (EIB) model is alleviation of high governmental spending related to social or environmental problems (Costa & Shah, 2013).

Another option as a financial tool is Conservation trust funds which were developed based on samples from other models in the areas of nature conservation. This type of model is structured well and developed for implementation of environmental conservation projects. It has long time frame which allows to create the local capacity and work as an be independent entity.

The basic principle of conservation trust funds is a creation of stable access to finance in order to develop sustainable equity in terms of usage of natural resources not only by present generation but also future generations as well.

Trust can be defined as a legal mechanism "in which assets are managed by one group (the trustee) on behalf of another group (the beneficiary)" (Mikitin & Osgood ,1995). In case of conservation trust funds, we consider grants or other financial investment funds as an asset, while, the trustee is considered to be a board of directors, and the beneficiary are the local Non-Government agencies. Conservation trust funds are public entities, because they main mission is to provide finance to public purpose projects (Danish, 1995).

Success for conservation trust funds is not only about creation financial mechanisms but in addition, it is development the self-governing institutions, which has proper well developed strategies to work with public as well as private agencies. As was stated by World bank, Global Environment Facility program, the main task of Conservation trust funds is to improve the effective management approaches and help Non-Government Organizations (NGO) with capacity building programs. Trust-fund plays important role as a resource for long-term sustainability. If there is a need to solve the environmental issues in short time, the conservation trust fund is not very proper solution. By itself, trust fund can "generate a range of benefits that contribute in non-specific ways to the development of sustainable societies" (Guerin-McManus, 2001).

Patton (2011) presented the short case study about credit union, showing the strategy of developmental impact investing in practice. This development is also consolidation of the capital allocation between not-for-profit and for -profit investment,

what has impact on expansion of opportunities in terms of stimulation of social innovations.

2.3 The Main Idea about Investment in Conservation

The main idea of investment in conservation is to provide the financial capital towards environmental projects to get the environmentally sustainable impacts, as well as be able to obtain the financial returns. Along with the decision making on maximizing positive environmental impact there is variety of issues in terms of implementation of appropriate approaches to gain maximum benefit from projects (Nicholls, 2010).

It can be a complicated strategy of financial risk management which involves the strategy to obtain the financial returns while operating the structural uncertainties and constraints. According to Freireich & Fulton (2009), that impact investment is still growing tendency characterized by a high level of risk and having the range of different opportunities as well as challenges.

One of the main and important opportunity is the fact that the interest in impact investment is growing among different private capital providers. Investors are interested in portfolio diversification. Especially, the interest tends to be growing among the wealthy investors who is looking for the "new approach to money management that enables them to also make a difference." The interest can be also explained by focus in such growing markets like India, China, and South Africa, the developing countries where there is a better connection of investment to public benefit opportunities. It creates a potential to develop social or environmental benefit. There are the also the corresponding challenges for impact investment.

2.4 Challenges in the Research

One of the core challenges is the lack of appropriate mechanisms which could help to connect capital and impact investment opportunities. Many investors and intermediaries have misconception about implications of social and environmental considerations and they think that that there should be a fundamental tradeoff between financial returns and impact. Unfortunately, there is no exact measurement tools for financial risk and social or environmental impact which make them more transparent. Moreover, there is an uncertainty in financial performance of many impact investments, even though these investments might provide the reliable return. Such factors make valuation quite challenging (Freireich & Fulton, 2009).

Hildebrandt & Knoke (2011) indicate that financial assessment together with investment analysis of forest related projects are more difficult because of the long-term duration of projects. The positive incomes can be expected only after several years in the future, what makes it uncertain and risky, while the decision have to made before the starting date of forest projects.

Since the most of the benefits in forest projects can be received after long time, the factor of sustainability is one of the main factors which plays important role in forest management. The diversification is the strategy which can help in consolidation of uncertainty into decision-making processes in order to provide the solid net benefits from forest projects.

2.5 Valuation Methods for Forest Projects

The main focus of traditional approaches is expected cash flows and calculation of net present values. But due to uncertainty, it is very difficult to apply traditional methods in practice. Cubbage, Davis, Frey & Behr (2013) mentioned the traditional valuation approaches such as cost-benefit analysis (CBA) or benefit-cost analysis (BCA). As discussed in paper, there are several main stages of the analysis such as: defining the project objectives, data collection, calculation of the cost of inputs, cash flow forecast, estimation of financial returns, implementation of project and last stage is control and evaluation. There is another discussion by Meade, Fiuza, Lu, Boyle & Evans (2008), about possible valuation approaches for forest land valuation. One of such methodologies considered to be Comparable Sales Analysis. This approach is about using the transaction data to "assessment of carbon pricing on value". The application of this method is limited, because of restricted sales data and poor technique to value the forest.

Another mentioned approach is Discounted Cash Flow (DCF) analysis, which based on the discounting the future cash flows at certain discount rate. According to Duku-Kaakyire & Nanang (2004), DCF is method which cannot properly address business valuation of growth opportunities or by other words not applicable for large-scale projects. As was mentioned, the main fact of limitation of implementation of DCF method is significant amounts of related to forest projects risks as well as uncertainties in forest production and prices.

Miller & Park (2002) describe the Internal Rate of Return (IRR) and Net Present Value (NPV) as well known valuation methods, but which require assumption of certain future cash flows, what considered to be not applicable in terms of forest valuation.

Implementation of NPV method leads to accept the project immediately if NPV is positive, which has limited application under uncertainty. As alternative, there is a discussion about using the Real Options Analysis (ROA) as valuation tool for investment decision. ROA has different financial option pricing techniques, which allow managers to get several of possible outcomes for "single investment".

ROA gives option in making decision regarding investment timing as well as reduce or expand the capacity of production or abandon the project (Yeo & Qiu, 2003). The option "provides the right, but not the obligation, to buy (call option) or sell (put option) an underlying asset at a fixed price by a certain specified time in the future". There are two types of options to exercise the contracts such as: European and American options. For European options there is definite day of expiration when contract can be exercised only, while American options have period of time during which the contracts can be exercised. In case when, there is investment decision about new land use, the American call option is under consideration. While, in case of particular land use, there is a put option is under consideration (Tubetov, Musshoff & Kellner, 2012).

There is number of different points in terms of investment and each point has. The implementation of real options approach provides the number of different value options for investors. Based on the provided options, investors can have an idea about further actions (Dixit & Pindyck , 1995). The real options values can have significant impact on investment. The three main methods which widely used for real option values calculations are: partial differential equations, simulation, and lattice methods were presented by Mun (2006). One of the most well know partial differential equation, which considered as analytical, mathematical approach to valuing real options is Black-Scholese (BSM) model. This model

calculates the values of options by using the equation which allows to change the options value based on the change of underlying asset's value. Based on the assumption of BSM, there is a possibility to create a risk-free hedge portfolio which will consist of a long position of timber and short position of call on that timber.In case when the price of the timber changes, the risk-free hedge can be regulated by adjustment of timber and calls proportion (Gjolberg & Guttormsen , 2002).

The main advantage of this model is that it is possible to calculate the large number of option values in the short period of time. (Dixit & Pindyck , 1995). The BSM model has limitations as well. There is consideration of one source of uncertainty based on BSM model. While in implementation of land use investments because of the long-term maturity of the projects there are usually several sources of uncertainty. If there are multiple sources of uncertainty there is need to apply more simplified assumptions (Gilbert, 2004). It was mentioned by Trigeorgis (1996) that based on assumption of BSM model, the options can be exercised only at maturity date. It means that it is useful for the valuation using European options. But when we are considering the investment related to land, it is better to use the American option which can be exercised at any time for the period of contract.

It was also indicated by Petrasek & Perez-Garcia (2010), that since timber harvest is possible only in the end of contract period, the implementation of American option can provide more precise valuation of timber contracts, than European style option.

2.6 More Appropriate Real Options Techniques

There are other valuation models which can be applicable for valuation of forest-timber. One of such models is binomial method which applicable for the low dimensionality and standard dynamics problems (Cortazar, Gravet & Urzua, 2008). It shows the price movement over the time, where the prices of assets can change based on possible price probabilities. In general, it is considered to be a complicated process which is difficult to utilize in real-world decision making. This is particularly relevant to investment problems in management of land use which are usually specified multiple uncertainties.

A main problem with mentioned above option valuation methodologies is that they are not easily extended to more than a couple of stochastic factors. In the binomial model, the reason is that in practice, "the number of nodes required grows exponentially in the number of stochastic factors". Simulation can be considered as a possible solution for such problems (Stentoft, 2004).

First, the simulation methods which can be applicable for asset pricing was introduced by Boyle (1977). It is randomly simulating the large number of possible future variations for uncertain variables. And the most common approach in this case is Monte Carlo simulation (Mun, 2006). Implementation of simulation method for real option problems implies a distribution of range or expected possibility in future asset values. The Monte Carlo simulation has a comparative advantage over the other valuation methods. There is an ability possibility to work with multiple uncertainties, regardless if they have non-standard distributions, changing distributions, or are correlated (Triantis, 2003). The

other important characteristics of Monte-Carlo simulation is that it gives overview of future decisions based on the past outcomes or decisions (Longstaff & Schwartz, 2001).

As was mentioned before, the real options techniques were using the European style options and there was no approach to be able to apply the American style options, particularly with simulation. The main problem was related to exercising the options on the earlier stages of contracts, which is applicable in American options. With development in calculations and technologies and methods, there are several methods of implementation The Monte Carlo in real options (Boyle, Kolkiewicz & Tan, 2003). One of them is Bermudan options, which mainly involves the pricing options with some limited number of valuation opportunities to exercise the contract. The other method is stochastic mesh methods (Broadie & Glasserman, 2004).

Longstaff and Schwartz (2001), proposed least squares regression, hereof, Least Squares Monte Carlo (LSM) method. It is about integration of corporate least squares regression with simulation, which allow for the valuation of real options, involving several aspects and can be applicable for American-style option (Cortazar, Gravet & Urzua, 2008; Longstaff & Schwartz, 2001).

As was discussed before, there is a problem in valuation of the timber harvest contract for an American option, because it was no solution and there were no technics which could help to solve the problem. But it became clear that the American options provides more operational flexibility at the disposal of contract buyers. It became also more obvious that by using the American option it was possible to get more accurate valuation of timber harvest contracts, since the value of the contract mainly depends on time when to harvest. By other words, the contract value with stochastic timber prices can

be considered as expected discounted profit which can be gained by harvesting at the optimal time. And consequently main problem with getting the better valuation price could be solved (Petrasek & Perez-Garcia, 2010).

Based on the research and literature reviews which helped to get dipper idea, the Least-Squares Monte Carlo Simulation method is used in current study as a method to of valuing the timber contracts. The results from the study can improve the understanding and thinking about possible tools to better manage the forest projects and provide better idea how to attract the financial investments to make the forest management more sustainable. Starting from the first section and continuing to the next, there will be more deep explanation the different aspects of forest related issues and possible solutions which were provided not as a panacea but possible guidance in implementation different options. Section six describes the possible framework for option valuation and implementation of LSM method. The last sections are providing the results and conclusion of the paper.

Chapter 3: Forestry Issues and Solutions

3.1Forestry Degradation, its Effect on Environment

Since forests is one of the main life resources for millions of people it has significant influence on "economic development of many countries". One third of global land is covered by forest which provides the employment for many people.

Based on assumption there are about 410 million people are high level of dependency on forests for subsistence and income, and about 1.6 billion people depend on forest goods and services for some part of their livelihoods. According to the annual report of Food and Agriculture Organization (FAO), annually the value the forest production brings to the world market economy is more than $450 billion, and the internationally trade value of forest products is between $150 billion and $200 billion. (Changes in forest production, biomass and carbon: Results from the 2015 UN FAO Global Forest Resource Assessment), (Köhl, Lasco, Cifuentes, Jonsson, Korhonen, Mundhenk & Stinson, 2015).

According to United Nations Environment Program (UNEP) publication, forest has multiple values such as:

- Many medical products made based the ingredients obtained from forest. In addition, the pharmaceutical companies are creating the new drugs and other medical innovations using ingredients from forest products;
- Forests play a key role sequestering carbon dioxide as a way to reduce the impact of global climate change. Globally the overall carbon storage of forests constitutes 54 per cent of the 2,200 gigatons of the total carbon pool in terrestrial ecosystems. The average

maximum potential carbon sequestration rate from forest consist of 1.1–1.6 gigatons per year, including above and below ground pools.

- Forests are important in helping to produce clean water in rivers and streams by reducing sediment loss from watersheds;
- Forests help to maintain flow pattern in rivers, by promoting the infiltration of water into soils, and helping to maintain higher base flows during the dry season. Forests can help in improvement of local and downstream water quality, promote aquatic health, including in fisheries;
- Forests help to provide inputs for healthy soil as well as increase agricultural production and decrease soil losses;
- Timber and non-timber forest products such as tropical nuts, rubber and rattan which can be used for local and also for global export markets. Non-timber forest products play important role in the livelihoods of the many poor households living nearby the forests, especially in the tropics;
- Forests are habitat place for many wildlife animals what is also very important for natural biodiversity and could be as a basis for a productive ecotourism industry.

  If all of the benefits which forest can give would be taken into account and if forest could be managed more properly, it could bring more economic efficiency in long term (Munang, 2011).

But unfortunately there are many issues caused by unsustainable usage of forest which is the main source of deforestation. Some studies reveal that the main reason of deforestation is expansion of agricultural land because of increase of population and a decline in agricultural production.

Another issue that in developing world the forest still used as fuel wood what cause addition burden, not-reasonable-use of nature resource – sustainability issue (Assefa & Bork, 2014).

The World Bank (2010) reports that in average net global deforestation is about 7.3 million hectares a year from 2000 to 2005, contributing about 5.0 gig tons of carbon dioxide (CO2) a year in emissions, or about a quarter of the global emission reduction needed. Based on report of Intergovernmental Panel on Climate Change (IPCC) (2007), emission caused by deforestation account for about 17 % of total greenhouse gas emissions, which is larger than all the world's emissions and has the same size as the industrial sector (Tetsuya & Shunsuke, 2011). According to the Global Forest Resources Assessment 2015, the deforestation has decreased and afforestation has increased globally during 1990–2011. In terms of different countries, there is a forest gain in developed countries, while still forest loss continues in poor countries in the tropics. Some of the middle income tropical countries are now also transitioning to forest gain. These countries which are in transition period right now having forest management reforms together with improvements in agricultural practices as well as Forest Landscape Restoration projects with deviations of 6±7% globally and 6±17% for the tropics. Since 1990, globally, the forest area increased by 8.5%, mostly in tropics. In low income tropical countries there is only 37% of forest coverage since 2010, so still much work with management of forest is needed (Sloan & Sayer, 2015). Growing demand for forest products requires the expansion of forest areas. Planted forests or by other words, Forest Restoration Projects can reduce the pressure on natural forests as well as provide the support to biodiversity conservation.

3.2 Importance of FLR and Opportunities for Different Stakeholders

Forest and Landscape Restoration (FLR) is an emerging process which implies the active involvement of stakeholders in all affected land-use sectors as well as participatory decision-making processes. According to the Global Partnership on Forest and Landscape Restoration (GPFLR), FLR is "an active process that brings people together to identify, negotiate and implement practices that restore an agreed optimal balance of the ecological, social and economic benefits of forests and trees within a broader pattern of land uses". When we are talking about FLR, we consider the approach which can create the balance between restoring ecosystem services such as: wildlife habitats and biodiversity, water regulation, carbon storage and productive functions of land for agriculture and other related uses (McGuire, 2014).

The scale of implementation of Forest Landscape Restoration (FLR) projects can vary based on purpose. It can be related to restoration of particular portion of landscape or it may cover several objectives. The establishment of sustainable land-use management practices, the improvement of the land productivity as well as mitigation of land degradation, water and soil protection, providing the support to local communities by teaching them how to increase the forest productivity, all of these can be included into FLR initiatives.

Restoration can be successful only if there is an integration in planning which can be based on community land planning and decision making, cooperation among different government agencies, improving the local land institutions and land management policies. Forest landscape restoration projects is an opportunity to recover the burden given to the land and make balance between ecological, social and economic benefits of forest (FAO,

2015).The concept of FLR includes broad and intersectoral approaches that covers different areas such as: assessment of landscape degradation and restoration opportunities; environmental policies, regulations; issues such as: land ownership rights, involvement of local community; technological approaches; development of capacity and private sector investment.

It is very important to consider the quality of FLR implementation in identifies areas, especially in regions that deliver important ecosystem services. Such factors like: reduction of natural habitat cover, loss in other natural ecosystems have to be avoided. The vulnerable land areas which have contribution in sustainability have to be protected and appropriate level of restoration has to be implemented.

Regardless of the size of forest landscape restoration area, in order to get effective and sustainable results there is need of public investment (Brancalion, Viani, Strassburg & Rodrigues**,** 2012).

As was mentioned the forest gives not only shelter and food for the people, particularly farmers, but it is providing the employment and bring other monetary benefits. By creating small and medium enterprises, the farmers can grow variety of plants and trees and get revenue. Forest by itself has long term turnover and it will take a several years before would be possible to get the yield from the forest. However, the diversification in plants and proper forest management can help to get the yield of forest plantation in the shorter time. Of course, it is a big work and sometimes, especially in developing countries, the farmers are not able to improve the situation by themselves. They need support from the government and nongovernment programs. In this case we need to think about public and private partnership in order to develop the forest management programs and make

them more sustainable. The task of public side or government is to provide the technical assistantship such as training programs for farmers. By private support we assume the investments to make the forest management more sustainable.

The sustainable forest management can benefit not only farmers but other stakeholders as well. First of all, we have to mention the government by itself. The better the forest lands managed the wealthier the farmers, what positively influences the economy of the whole country. In addition, the better the forest conditions, the healthier the population, the better the ecology and more opportunities for the future generation.

Other category stakeholders which can be considered are non-government organizations. They can function based on the development of forest management projects and by doing good job, can be more profitable and run their business and attract more investment.

The last but not less important stakeholders are private investors which can also get benefits from forest management projects. One of the obvious benefit is interest rate or by other words is rate of return from the investment into the forest. In addition, the forest production can be sold on the international market as a part of investment return and can bring a financial income for private investors.

As was discussed in previous part, all of restoration projects need the funds for implementation. The funds can be attracted in different ways but in general, all the funds are coming from investors. So what are the problems which can become as an impediment in getting funds. They are following:

- Most of the forest projects are long –term projects, so the benefits can be applicable only after several years of work;

- There is an uncertainty in getting the cash flows in forest, due to price volatility and other factors like force major etc.;
- Due to uncertainty there is a risk for the investor in not getting the invested money back;
- There is not unique structure and measurement in how to measure and forecast the future yields of timber.

Chapter 4: Investments and Perspectives

4.1 The Role of Investment in Forest Restoration

4.1.1 Potential Market for Investment

Since one third of global land is covered by forest there are many countries which can be considered as a potential market for investment. Mainly market can be divided into two categories, such as: developed countries and developing countries. The approaches or structures used in developed countries should be adjusted for developing countries due to several aspects which include legislation, investment climate, level of economy etc. All of the mentioned and other aspects should be considered individually for each country, based on analysis and professional expertise.

There are various different sources to finance the forest. It includes: the government budget, sale of forest products and services, investment from private-sector.

For many countries, the main source of financing for forestry is private sector which comparatively increased in recent years. According to the Policy Brief of Forest Agriculture Organization, about 80 - 90 percent of financing for forestry coming from private investment (FAO, 2008). The most part of the private investment is direct investment. But another type of private investment, such as indirect investment (forest funds) increasing in importance. The private investment like, funds are focused on socially responsible and green investments, which can be also applicable to finance the forest. The stimulation of private investment into the forest can be increased by development of mechanisms for the payment of environmental services. In the same time, it can increase the financial returns from sustainable forest management. In terms of the public-sector, it plays an important role in financing and has three different levels for investment. If we will consider the financing the forest, so, most of

the time, it can be only the source of finance for forestry activities that produce social and environmental benefits. Second, it can be considered as a support level for private-sector investment with incentives such as grants or subsidized loans. The last level is responsibility in providing the technical assistance (policy and institutional environment) which can encourage the private-sector investment. For example, according to the FAO survey, several countries in Latin America have used innovative approaches to public-sector financing of forestry, including "ring-fencing" budget allocations for forestry (Guatemala); earmarking taxes for forestry (Brazil); and public-private partnerships (PPP) or revenue sharing arrangements (FAO, 2008).

There is a big difference between public and private investment. Each of them has significant influence on success of forest landscape management and its sustainability.

Private sector actors have a different range of instruments that can vary based on the time period of FLR projects. The private sector is often considered to provide greater efficiency than the public sector in managing infrastructure projects and delivering infrastructure services. Involvement of the private sector holds the potential to increase operating efficiency by making investments in new technologies, bringing innovative solutions, and encouraging more transparent organizational structures. This often results in better governance and improved transparency, competition, and accountability, and thereby improves value for money. The PPPs, in particular with a long-term contract, can bring significant benefits for government in the delivery of public services and asset creation. Usually PPP projects are bid out in an open and transparent manner wherein the participating bidders are provided with sufficient information on the evaluation of bids and contract awards. This is critical as, unlike conventionally procured projects, PPPs that involve raising limited recourse financing require

private sector companies and their financiers to bid not only for the right to deliver a public asset, but to provide up-front funding as part of a long-term contract agreement with the procuring authorities to design, build, operate, and maintain (Asian Development Bank, 2012).

The success of Forest projects can depend on the involvement of different stakeholders and types of finance. It also depends on appropriate combination of assets and enabling investment. One of the other important factor which play crucial role in success is experience and expertise of financial institutions. Proper financial investment can create tangible value with additional interest rate for investors and profit for forest owners.

The sustainable development of Forest landscape Restoration projects requires interest of stakeholders in collaborative process of project management. This includes the landowners, local government entities and local businesses, as well as international stakeholders not directly related to specific region. The close relationship and appropriate institutional structure are required as initial foundation for projects implementation.

None of the mentioned above would be possible without related proper regulation of laws and procedures. Different sectors have a different policies and regulations with applicability just for certain area of interest. Moreover, appropriate resource rights and ownership systems should be in place. One of the most important aspects is property security and access rights for individual forest land owners, users and for the long-term investment strategies in general.

It can be a variety of different public and private financial actors in implementation of Forest projects. The main objectives such actors like government or NGO is provision of public goods. Another types of actors, including social and environmental impact investors

and development finance institutions have multiple priorities. But in general, the main objective of all types of investors is to get the financial return (Shames, Clarvis & Kissinger, 2014).

Below, there is a Figure 1., which shows the motivation of different stakeholders regarding investment in natural resource conservation.

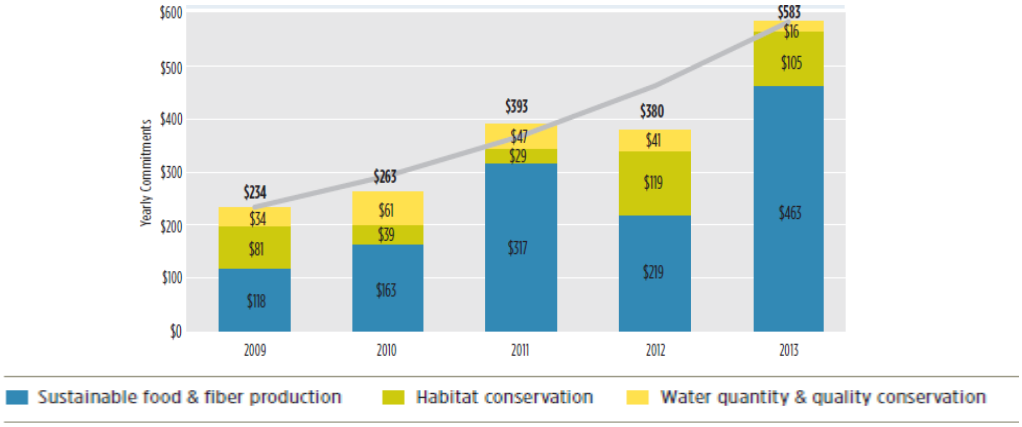
Figure. 1

Adopted from: Shames, Clarvis & Kissinger. (2014).

4.1.2 Conservation Impact Investment

Conservation impact investment can be defined as an investment which creates the financial return and positive environmental impacts. The first study of nature conservation related investment "Investing in Conservation" revealed that $23.4 billion was spent for global conservation impact investments from 2009 to 2013 (Nature Vest, 2014). International Finance Corporation provided $21.5 billion of investments and private investments reached about $ 2.0 billion. For the period of 2009-2013 covered by the study, private sector investment increased by 26%. The level of growth differs depending on environmental subsector. The categorical difference of private investment is presented in

Figure 2.



Adopted from: Nature Vest (2014).

Figure 2: Private sector investment, 2009-2013 ($ millions)

In Figure 2, the growth of private investment is 26% for the five years' period. Comparatively, substantial growth was seen in investment in the category of sustainable food and fiber production. Based on information provided by the study, from 2014 through 2018 the private investment capital will increase to $4.1 billion. The main idea of conservation impact investment is bringing together both the demand and supply sides. By demand side, we consider environmental projects with financial needs. The supply side has potential donors with available investment. "There is a significant unmet demand for the funding of conservation programs to preserve ecosystems at a global scale. Conservation finance can activate and scale up cash flows from conservation activities" (Credit Suisse, McKinsey & Company, 2014). However, it is challenging to create a mechanism for cash flow generation (activate financing through traditional capital markets). One such mechanisms is when investors put their funds into investment structures such as environmental impact bonds (social impact bonds) or as another option can be conservation trust funds.

According to Nature Vest (2014) research paper, investment can be classified by two main groups: for- profit investment and not-for–profit investment. The top motivation to invest in nature conservation for–profit investors is expected financial returns. After that motivation there are other conservation and non-conservation objectives which can include also the diversification of investment portfolio. From the other side, for not-for-profit investors, the most important is conservation objectives by itself. The tables below present the ranked classification of motivation of for-profit and not- for-profit investment.

Table 1: Motivation for making conservation impact investments - For-profit organizations

	Total score
Expected financial returns	49
Viewed as strategic tool to advance organization's conservation objectives and mission	44
Viewed as strategic tool to advance other objectives (e.g., economic prosperity)	29
Considered as part of asset and investment diversification	13
Personal interest in the sector	10
Considered part of corporate social responsibility strategy	8
Other	8

Data provided by 33 respondents. Adopted from: Nature Vest (2014).

Table 2: Motivation for making conservation impact investments - Not-for-profit organizations

	Total score
Viewed as strategic tool to advance organization's conservation objectives and mission	37

Viewed as strategic tool to advance other objectives (e.g., economic prosperity)	22
Expected financial returns	9
Considered part of corporate social responsibility strategy	2
Personal interest in the sector	2
Other	2
Considered as part of asset and investment diversification	-

Data provided by 16 respondents. Adopted from: Nature Vest (2014).

The responses from all investors – for-profit and not-for-profit were calculated by adding the scores from Tables 1 and 2. The advancing an organization's conservation objectives was the choice which got the highest score after expected financial returns (IRR).

According to the paper, the expected interest rate return depends on country and its geographical location, which shown in the Table 3:

	IRR range	Reported investments ($ millions)
Western Europe	0-4.9%	13
Asia & Oceania, excl. Australia & New Zealand	5-9.9%	16
Australia & New Zealand	5-9.9%	75
Latin America	5-9.9%	59
Canada & USA	5-9.9%	990
Sub-Saharan Africa	10-14.9%	141
Unspecified emerging market*	10-14.9%	22
Overall	5-9.9%	$ 1,316

**Refers to cases where the respondent did not indicate the emerging economy in which the investment was made*

39 respondents reported data. Adopted from: Nature Vest (2014).

Data in the table shows that the lowest IRR is mainly in Western Europe and the highest percentage is in the countries of Sub-Saharan Africa. It means that IRR depends on economic development of particular country. The less developed countries have the highest interest rate and reverse.

Conservation impact investments considered to be different from traditional investments, because of the objectives and goals (Doherty, Haugh & Lyon 2014; Lehner 2012). Therefore, in order to be able to measure the impact of such investments and be able to generate the financial returns new financial approaches are needed.

4.2 Accessible Financial Mechanisms

4.2.1 Environmental Impact Bonds as One of Financial Tools for Nature Conservation

There are different financial approaches which can be considered for financing the forestry management. One of the approach is Environmental Impact bonds (EIB). We can consider the applicability of EIB for nature conservation. The other financial approach could be financial funds, which works as accumulation of interest rates of investments and in the future can be used as accessible finance for forest and other environmentally oriented projects.

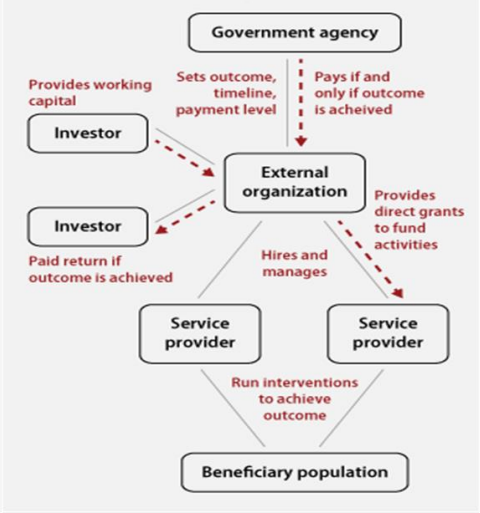
As an innovative financial tool, EIB enables government agencies to pay for achieved goals. EIB is a partnership of government agencies together with private capital and non-profit sectors. The main condition of this mechanism is that the government only pays for a return on investment if the social investment program meets or excesses the impact performance target. SIB is one of the tools in the investment market that provides financial capital to the private sector for resolving complex social problems.

Implementation of EIB is an opportunity to reach more people through effective programs than would be possible by government grants alone. Like other financial tools, SIB involves the participation of investors with the same procedure steps for implementation as other investments types. The main procedure that helps to ensure the control of quality and performance management is due diligence. Further, there is a requirement that the decision on repayment has to be made based on proper social and financial data.

Another requirement of the program is to have contracts between the external, usually nonprofit, organizations and other groups that have direct involvement in the implementation of projects. These external organizations obtain capital from investors as capital funding for the social programs. In addition, the service providers are required for the actual work of project implementation (Costa, Shah & Ungar, 2012).

The main concept of social project investment system is presented below by Figure 3.

Figure 3: The concept of a social project investment system



Adopted from: Costa, Shah & Ungar (2012).

After completion of the project and assessment, the government will make a decision about paying back funds to the external organizations based on their success.

Thereafter, external organizations will repay investors with an agreed interest rate. Since external organizations have the primary responsibility for implementation and control of social impact bonds programs, it is in the best interest of the government to provide support for finding the appropriate service providers to reach the target goals. The impact of the implementation of social impact bonds approach has to be measured based on the benefits that the government will be able to achieve in a long run. Figure 3 shows the concept of a social project investment system.

From the concept of a social project investment system, we may define the main stakeholders as follows:

- Government presented by government agency;
- Investors;
- External organizations (nongovernment organizations);
- Service providers;
- Independent assessor;
- Beneficiary population.

4.2.2 Structural Mechanism of EIB

According to Nicola J.D. "Environmental Impact Bonds", who researched at Duke University, there is "Pay-for-Performance" (PFP) mechanism and three potential SIB structures which are important for the future SIB and EIB implementation (Nicola , 2013). The Principal-at-Risk and Return-at-Risk are the two main forms of PFP (pay for performance). The main idea of Principal-at-Risk form is providing the principal and interest to investors as a lump sum payment at maturity. While, Return-at-Risk is a form

of (PFP), which is more similar to traditional "bullet" bond where investors receive the annual coupon payment as "bond principal" at maturity.

There are two sub forms of this mechanism. The 'Standard' Return-at-Risk and 'Annual Bonus' Return-at-Risk. The sub forms can be useful in cases when the performance target of the social (environmental) program is not met. They help with initial costs to adjust the total amount of investment made, but there is no interest rate for return to the investor. The gross amount of cash flows to investment for some term of a project would be equal to the original one. The 'Annual Bonus' Return-at-Risk can be adopted if social or environmental issues are measurable. If impact measurement can be applicable in the end of the project, then 'Standard' Return-at-Risk is most appropriate.

The Principal-at-Risk and Return-at-Risk have to be determined properly as well as 'Standard' and 'Annual Bonus' sub forms. Their applicability can vary based on different conditions of investment contracts, investor risk preferences, project impact measurements, and relative outcomes. The Principal-at-Risk is more applicable for the investors with the high performance of stability and ability to take a risk, while Return-at-Risk is more applicable for traditional and conservative investors with less preference to risk. In cases when the target of the social program was not reached, the investors will lose the principal of their investment or some part of it. The potential loss can be measured based on the efficiency of social or environmental project, which will stay unhedged for the duration of the project. Whereas Return-at-Risk provides more protection for principal amount of investment from the impact risk. In order to make the Principal-at-Risk more attractive for investors, the following factors are suggested to be considered:

- It is necessary to provide more rewards for high risk projects. This can enable investors to increase the amount of investment principal for the duration of the project and take a risk;
- Provision of additional guarantees;
- Provision of different capital structures tranches for investors.

The Principal-at-Risk and Return-at-Risk approaches can be most appropriate for specific cases. There is no requirement of investments return until the end of the project in Principal-at-Risk approach. Therefore, this approach is more applicable for social and environmental impact projects where usually there is a long term of maturity. It is also beneficial for government and nonprofit organizations involved in projects. Most of the social and environmental issue projects will be applicable for the Principal-at-Risk structure because the measurement of impact will be more accurate after a longer period of time. The structure of Return-at-Risk, however, is more appropriate for social and environmental projects, which can be measured more frequently. The 'Annual Bonus', the sub form of Return-at-Risk technique, is also applicable for such type of projects.

4.2.3 Financial Funds

The conservation trust funds are usually financial grants or other donor funds that finance the public purpose projects implemented by non-governmental organization ("NGO") (Guerin-McManus, 2001). Conservation trust funds can be defined as "*private, legally independent grant-making institutions that provide sustainable financing for biodiversity conservation*". (Briand & Carret, 2012).

Many conservation funds were established in 1990's mostly from U.S. programs, or through grants from the Global Environment Facility (GEF), which is managed by the

World Bank. Because of the nature of this approach there were much concerns about risks and duration of funding. In the same time, it was considered as innovative. One of the innovative characteristics was that the Board of Directors were established independent of government, but connected and dependent on government biodiversity policy (Adams & Victurine, 2011).

Conservation trust funds are mechanisms that provide sustainable financing for biodiversity conservation. The funds necessary for the conservation projects are raised from major international donors, national governments or it can be raised from the private sector and provided to NGOs, community organizations or governmental agencies implementing field activities. Structurally the CTFs can be considered as public-private partnerships (Briand & Carret, 2012).

The trust funds can be one of the solutions for the long- term conservation projects or by other word, sustainable based projects. Bayon, Deere, Norris & Smith (1999) describe that there are three types of financial structure of environmental funds. They are following:

- **Endowments,** investment of capital and usage of the income from those investments to finance activities;
- **Sinking funds** developed to disburse their entire principal and investment income over a fixed period of time (usually 6-15 years);
- **Revolving funds** that receive new resources on a regular basis—e.g., proceeds of special taxes, fees or levies designated to pay for conservation programs—which replenish or augment the original capital of the fund and provide a continuing source of money for specific activities.

As other financial tools the conservation funds have own benefits. The primary benefit of this approach is that the funding goes directly to finance the essential conservation services. It provides the regular funding stream and sustainable development of long term benefits. It contributes to the creation of economic opportunities for improvement the living standards of rural population. In addition, such kind of financial tool plays important role in corporation of institutional partnership and leveraging the expertise to attract the new sources of funding. Sources of funding for conservation

There are several primary sources for funding of conservation:

1. Government Funding

2. Donor Funding including Non-Government Organizations (NGO), foundations and individuals

3. Payments for Eco-System Services(PES) including forest products, water rights and tourism fees

4. Corporate funding including compensation payments and offsets to create protected areas (Business Biodiversity Offset Programs).

The negative previous experiences of donors providing grands primarily for funding short-term programs and lack of experience with endowed organizations created the big concern in making investment in nature conservation today and get income only in uncertain future. Creation of the Conservation Trust Funds has been helpful in providing stability for the budgets and success of biodiversity conservation programs. It also helps to attract donors and make them aware that investment funds are managed effectively and can generate consistent returns. The income from these investments can improve the achievement in conservation results (Adams & Victurine, February, 2011).

According to Alliance-CFA, C. F. report (2013), the main problem of financing the conservation nature projects in most countries is the fact that the demand for finance is significantly higher than the supply of finance. Furthermore, this gap between demand and supply side is expected to increase over time.

Based on the findings provided in report, there are different measures which can be taken to reduce or eliminate the financing gap:

- The demand for finance can be reduced if it would be possible to increase the quality of service provision and develop cost efficiency programs. There is need for reforms finance management service provision, to make it more efficient and cheaper. Usually, when projects funded by donors, such projects focus on such reforms. One of the main comparative advantages of projects which funded by donors is the ability to implement best international expertise in conservation of nature management practices. In order to implement and use such expertize in conservation financial funds, more financial incentives are needed.
- Utilization of cheaper equipment and infrastructure can decrease the operations and management costs. In terms of conservation trust funds, it has an advantage, since typically knows better the domestic markets and requirements of end beneficiaries, what can make it more cost efficient. In the same time, by attracting the international donors, conservation trust funds can get comparative advantage in "procuring assets on international markets, as well as international expertise in realizing new infrastructure", if needed.

- If it would be possible to increase the transfers from public sources to the environmental projects, it would allow to focus on rationalizing planning system level in terms of management and related finance. The co-financing of conservation trust is necessary for the longer period of time.
- If it would be possible to increase finance from private sources into environmental projects. It could increase supply of finance for the nature conservation projects as well as decrease subsidies over time. In this case, the conservation trust funds have an important advantage, since it can leverage private and commercial finance in several ways. It can require private or commercial project about co-financing as fund support. In addition, conservation trust funds are usually having a good position in providing financial support to projects that generate revenues based on "sustainable economic and livelihood alternatives" (Alliance-CFA, 2013).
- By increasing finance from international sources, Conservation Trust Funds (CTF) can attract and coordinate the allocation of financial capital from multitude source of donors. Such donor cooperation can help CTF to become more experienced and mature in delivering the financial funds to beneficiaries.

There are also following advantages which would be reasonable to mention:

CTFs are the good resource which able to support individual projects, including small scale projects; They are capable in implementing of complex approach in project management, which includes: identification of project, due diligence of project, management of project contracts, project monitoring and project evaluation. If all of mentioned procedures are in good collaboration with international practice, it can become a powerful tool project quality improvement. If the structure of CTFs is managed in proper way based on domestic and

international experience together with implementation of new innovative approached, it can be excellent tool for development and improvement of project capacities. In this way, the better project results can be obtained.

While working with implementation of a conservation trust fund it is important to remember that there are key steps which have to be taken in to account. First of all, as was mentioned and described before the law regulations and procedures have to be in place. Second, all of the objectives and goals have to be stated and proclaimed to stakeholders-participants. Another important factor to be mentioned is selection of the board which also supposed to take place with special attention. Means, the diversification of representatives both professionally and politically have key impact on further working. Development of operation manuals which should be in place is the next step. As soon as operation manuals and other guidelines and rules for the grant process are established, the selection process of grant applicants can be processed. It is also important to remember that fund must also have a management unit which will be responsible for preparing work plans and budgets, as well as implementation and processing the grant proposals by partners, capacity building, financial systems and reporting.

Some conservation trust funds have technical advisory committees (TAC), by other word, experts who usually work on issues important to the fund. The mentioned committee can also provide the consultancy in finance, give advice in recruitment of the board or related to potential investments. The process of implementation of CTF also implies the training of the board of trustees, the management staff, and the administrative staff. All of information about the fund's activities and grant application process has to be transparent to potential fund beneficiaries. One of the final step which has to be taken is drafting the

monitoring and evaluation plan. It will allow to control and evaluate the project performance by partners as well as assess the impact and outputs. The well determined system of control is also a good source of getting information about partners and obtaining the data which can be useful for the database system in future. This particular knowledge can be used for projects improvement (Guerin-McManus, 2001).

The conservation trust funds are not only a stable source of funding for conservation, but also this type finance often benefits the community of different stakeholders such as government agencies, NGOs, local farmers as well as private sector. The long term goal of CTF is biodiversity conservation and sustainable recourse management (Conservation Finance Alliance Guide, 2003).

Conservation trust funds (CTF) are just one of the financial tools which can be used for nature conservation projects. It is not necessarily best approach for all countries and all cases.

According to Global Environment Facility(GEF) study (1998), there are four conditions needed for essential for establishing conservation trust funds:

1) The time requirement for the program to be funded at least 10 to 15 years

2) The establishment of public-private sector mechanism needs the support of government which can be outside of direct government control

3) The multiple number of stakeholders as well as big number of participants needed to be involved in nature conservation projects and sustainable development

4) Confidence in all established legal and financial practices and supporting institutions (Council, G. E. F.,1998).

4.2.4. The Conservation Trust Funds are more than just Financial Mechanism

The Conservation Trust Funds are more than just financial mechanism. They can be considered as environmental management institutions. It has the positive as well as negative sides. One of the positive sides of this entity is that it provides the greater awareness of necessity to conserve the nature and sustainable development promotion. It does a good job in involving the civil society and public institutions into collaborative action to reach mutual aim. One of the negative sides of current institution is that could also become very costly in terms of administrative and technical capacities. The CTF played important role in building institutional capacity and private-public partnership, developing less-bureaucratic management approaches. It had positive contribution in environmental management as well as environmental priorities and strategies.

The GEF report got conclusion that CTF had attracted highly qualified working staff, and they have high requirement in capacity-building which makes the overall work fulfilment with higher quality. In this case the Boards of directors also work much better due to initially it is high requirement for the individuals in each sector (Lambert, A., 2006).

There are following factors which are important for conservation funds foundation:

- There is significant environmental issue to be solved and it will take long time to work on it. The CTF has enough resources to manage the assigned tasks.
- The extensive support from government needed in order to develop a mixed, public-private sector mechanism that will be able without direct control of government.
- There is big diversification of sides involved in collaboration – government, NGOs, private sectors, different investment and donor agencies, which can have different

perspectives in terms of nature conservation but the main idea which integrate them is sustainable development of nature conservation.

- There is enough experience and expertise in a legal and financial aspects of partner entities as well as CTF.
- There are structural mechanisms which involve a range of different set of stakeholders in the process of design development full involvement of these stakeholders to use them.
- The new fund has to be established based on the experience of another fund or has to have support from the bigger and more experienced fund in order to have operational success.
- In order to be successful in current business it is necessary for the CTF to keep operating costs at reasonable percentage level

In the case if one of the first four conditions is missing, it is better to look for another possible financial mechanism. There is can be some issues to satisfy the other factors a s well, in that case, there is need of collaborative efforts from different stakeholders to mitigate the situation as soon as possible (Secretariat, G. E. F., 1998).

4.2.5 The Role of Stakeholders in Implementation of Financial Approaches

Each stakeholder has particular role in implementation of financial approaches. But currently there is a biggest influence of government which has the main role in implementation of each environmental project, starting with coordination of the contracts and up to the controlling the outputs and making the decision on the further work and development of new projects.

Another important role can be given to investors, because without financial input, whole project and ideas will be still only on paper and the environmental issues will never be solved.

The main beneficiaries who also can be considered as a main stakeholder are the farmers. Their role is ability to use all of the created process and activities to make the forest projects more sustainable.

The rest stakeholders such as nongovernmental agencies, insurance companies, accessors, banks are play intermediate role, but help to link the main processes and activities and it is considered to be a very important factor in making the final decision.

From the concept of a project investment system, we may define the main stakeholders as follows:

- Government presented by government agency;
- Investors;
- External organizations (nongovernment organizations);
- Service providers;
- Independent assessor;
- Beneficiary population

Theoretically we can build the chain and develop the work among the all mentioned stakeholders. But there are several problems that can impede the whole structure to work. One of the main problems is how to make the forest restoration projects attractive for the investors (Costa & Shah, 2013).

It is very important to remember about collaboration and close partnership of stakeholders -participants. By other words, there is public- private partnership (PPP) which

could play key role in implementation of nature conservation projects. A PPP refers to a contractual agreement between public (national, state, or local) and private entities which allows to share the skills, assets, as well as financial resources between each other, by other words, between the public and private sectors. In addition, it is also about sharing the risks and rewards, in order to provide optimal service delivery.

It is usual consideration that the private sector can provide greater efficiency than the public sector in terms of managing the projects. Involvement of the private sector has a great potential to increase operating efficiency by using the new technologies in investments as well as using the innovative solutions and making the organizational structures more transparent. While the public-private partnership (PPP) can significantly benefits the long term projects and help government in the delivery of public services (Asian Development Bank, 2012).

Different stakeholders involved in conservation finance have own functions:
For example, the role of investors is to provide funding to cover establishment costs, administrative costs; costs of monitoring the implementation of project, payments, other costs and funding expansion. From other side, the beneficiaries (farmers) mainly provide the input of resource. They are providing services or access rights to forests. In addition, incentives and support for sustainable land use. While when we are talking about role of managers, they provide fund management services together with administration of contract procedures with beneficiaries. They report, control and monitor as well as verify if benefit sharing mechanism performance in accordance to the requirements. In addition, based on experience, management tries to improve benefit sharing mechanisms. They assess long-term impacts of benefit sharing mechanism. There are other stakeholders, such as

implementing agencies who provide training and capacity building services, as well as they usually operate monitoring systems. They provide capacity building and training to beneficiaries (farmers) and in addition, they develop public infrastructure for the benefit of benefit sharing mechanism beneficiaries.

And the other type of stakeholders are independent valuators. The main function of such stakeholders are: to control, report and monitor the activity of fund managers or administrators. This type of stakeholder provides the capacity building and training to fund managers and administration staff (Chandrasekharan, Behr, 2012).

Chapter 5: Financial Mechanisms for Sustainable Forestry

5.1 Model of Sustainable Forestry

What do we consider by sustainability? The term sustainability in context of forest is about economic, social and environmental demands on the forest landscape. When balance of environment together with social balance are not violated due to increasing the production of wood. It is important to keep the economic and social balance of landscape while maximizing the production of wood and minimizing its cost. The quick rotation rate of trees has to be taken into account as well (The World Resources Institute & the World Business Council for Sustainable Development, 2005).

Sustainable Forest Management (SFM) is a management regime that integrates and balances social, economic, ecological, cultural, and spiritual needs of present and future generations (United Nations, 1992).

Sustainable forest management consist of following aspects:

- Economic:

The ability to attract investment in order to support the current and future great vitality of forest. There is no over usage of forest capacity for production of wood and other forest products.

- Social:

There are several following aspects such as:

- When the rights of local communities and people are respected and protected.
- Local farmers, communities have economically benefits from forest management.
- The lands which considered to have religious, historic values are preserved.

- Environmental:

The biodiversity (ecosystems, species, genes and ecological processes) of forest is protected as well as watershed protection, pollination, protection against mudslides, aesthetic beauty, carbon storage, etc.

This paper concentrated mostly on economic aspects of environmental sustainability, particularly in forest sustainability. As was discussed before, in order to make forest more sustainable, we need to develop and work on FLR projects. The key problem in this case is how to define which FLR project can be accepted to work with and which will not. In order to be able to calculate and define the value of the project we have to look at the available methodologies and evaluate which one is more applicable for forest projects.

5.2 Management Position

The main idea of forest investment project is that the owner of the forest as one side of the contract is holding the call options. By other way we can say that it is an option, based on the contract, which allows buying the timber at an exercise price given by the cost of cutting the timber.

The forest option can be exercised at any moment or negotiated time interval. This interval is given by the period when the price of the timber can have changed based on the demand on market. The timber selling price or call option price is a stochastic process that follow geometric Brownian motions. The decision investment decision about when be cut down the trees can be made based on the call option value (the highest call value to cut). The expected pay off can be obtained from several harvests. The forest management has to forecast not only the cash flows from the first harvest but also future harvesting as well.

There is possibility for investor to hold two independent options the same time and exercise the option with higher price at particular time (Cunha & Fontes, 2005).

Prior to making decision about investment there is involvement of comparison of net present values. How it can be related to the real option? The investment cost can be considered as an exercise price and the value of the project as the underlying asset. The comparison of three factors are involved in the decision to exercise the option. First of all, we need to take into account the dividends which were omitted due to not acquiring the asset today. The second factor is interest rate which was saved by postponing the strike price payment. And the last one is the insurance value which is gone due to option exercise. There is important issue of different interpretations of the term ‘‘management’’. Houghton, Werf, DeFries, Hansen, House, Quéré & Ramankutty (2012) proposed the interpretation of forest management as primarily the management of timber harvest, and as a result is methodology which is based in part on historical data about harvesting of timber. While based on FAO reports, the management has broad concept, which includes the cyclical utilization of forest production with different level of direct human impact. Based on given estimation of forest management impacts, it is possible to define the effects on natural disturbances. Due to historically wrong position of land management it was long-term reduction of forest land and as it has been converted to crops, pasture, and settlements for human life support (Pan, Birdsey, Phillips & Jackson, 2013). Although much of the world’s forest land has been permanently converted to other purposes such as food production or other social uses and will not be able to be converted back to the forest, the main task of the forest management is to develop and emphasize the structural mechanisms

which will positively affect the forest land expansion and in the long term the sustainability of forest land grow (Birdsey & Pan, 2015).

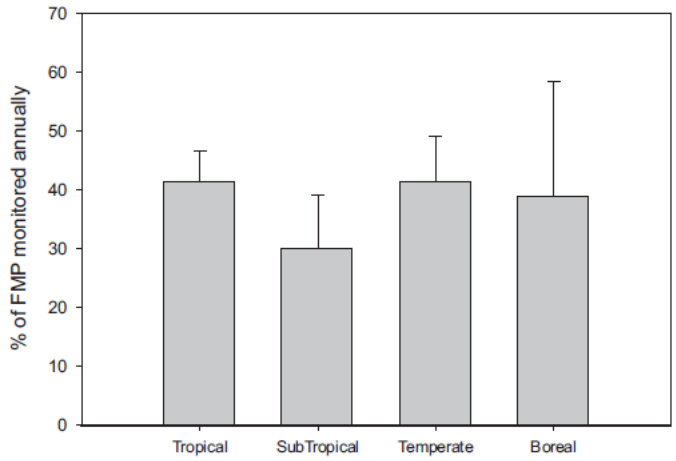
The integration of forests into a green economy could be considered as a main factor of long term sustainability and it will require innovative policies as well as market solutions. When we are talking about market solutions, it is assumption of dealing with consequences which related to forest loss. The direct funding from policymakers in forest goods and services can accelerate the development of sustainable forest management and help it to be more competitive in the marketplace. In the same time, Innovative solutions will accelerate the creation of mechanisms for more accurate forest assessment and provide incentives for long-term sustainable forest management. In ideally, ecosystem services markets have to be supported by supported by well-structured financial mechanisms. Generally speaking, the financial mechanisms have more important role than just tool. They can play the role of chain or channel which transfer the global interest into the local incentives for forest managers. Innovative mechanisms which used appropriately will allow to value the forests as productive natural assets which can generate goods and services at the local as well as international levels. But in order to reach such goal and to make the implementation of innovative mechanism more effective, there is need of good governance, best international and local practices and a well-developed control and monitoring system (Munang, Thiaw & Rivington, 2011).

Analyses of the Global Forest Resources Assessment 2015 (FRA) shows that the total area under Forest Management Plan (FMP) in 2010 was 2.1 billion ha or 52% of the total forest area. From 1953 to 2010, it was significant increase of forest in areas where management plans for conservation purposes had a key priority. In 2010 the area with

management plans for production and conservation purposes were nearly equal. If we will consider by regions, most forests in Europe, Asia, North and Central America were reported to be covered by a Forest Management Plan. But in the same time, territory of South America and Africa had the least coverage (<30% of sub-regional forest area). More northern part reported high proportions of area under Forest Management Plan (FMP) (87% and 63% respectively) in contrast with the tropical and subtropical parts, both of which had 28% under FMP. The Russia reported 100% of its forest under FMP while the rest of the northern part reported averages 63%. Some countries, such as Canada, reported only total area with FMP without separate values for production and conservation.

Below it is the Figure 4, which shows the average proportion of forest management plans monitored annually by climatic domain (bars are the standard error of the mean). the information from Global Forest Resources Assessment 2015 (GFRA) report showing the distribution of area covered by FMP:

Figure 4: Average proportion of FMP monitored annually



Adopted from: MacDicken, Sola, Hall, Sabogal, Tadoum & de Wasseige (2015).

Having the FMP does not indicate that that the forest management plans are supposed to be implemented effectively, however the presence of a FMP is a positive indicator and

initial step in order to establish good conditions for future Sustainable Forest Management (SFM). Also if there is no FMP in the country, it does not mean that there is no possibility to develop successful long-term sustainable forest management. It is not important to have the proper FMP but the involvement of government in implementation as well as in monitoring the processes needed on order to compliance with plans. Considering the forty percent of FMPs which were monitored based on annual data on the tropical climatic domain, followed by boreal (38%) and temperate (32%) domains (Fig. 6). In the subtropical domain, only 22 percent of FMPs were monitored annually. The frequency of monitoring depends on country. For example, as was reported in the tropics FMPs monitored once every 2.5 years. In reality many governments do have limited resources and cannot meeting the requirement of monitoring very often. According to the statistical reports, there are 29% of countries which cannot follow the monitoring plans due to financial scarcity. And this is only official data, while in real life the percentage can be much higher.

5.3 Analysis of Methodologies and Their Evaluation

When discussing a project, it can be assumed that costs and benefits occur over the life of the project. For example, forest projects are long term covering a substantial number of years. Costs and benefits from different years cannot be compared because of values may change depending on time and discount values. Therefore, the interest rate concept is required in financial analysis in order to calculate the rate for the project. There is no single, agreed-upon approach for this calculation. However, there are several common measures that can be adopted in economic and financial analysis. They are net present value (NPV) and internal rate of return (IRR). These measures are inter-related since they

are taken from the same data sets of costs and benefits of the project. In general, it can be shown that if a project has positive NPV, it is economically efficient and can achieve the desired benefits. In a case when NPV is negative, the project is then not economically acceptable. IRR is a rate of return on the invested funds for the period of project, or in other words, it is the rate of interest that makes the NPV (using market prices) equal to zero (Gregersen, Contreras, Campos, Arce, Finegan, Camacho, Quirós, Trejos & Platen, 1995). Either measures, NPV, IRR or ERR (economic rate of return), represent the relationship between costs and benefits. It can be presented by following equations:

$$Net\ present\ value\ = \sum_{t=0}^{n}\left[\frac{(B_t - C_t)}{(1+i)^t}\right] \quad (1)$$

$Economic\ rate\ of\ return\ is\ that\ discount\ rate\ (ERR)\ such\ that$

$$\sum_{t=0}^{n}\left[\frac{(B_t - C_t)}{(1+ERR)^t}\right] \quad (2)$$

where,

B_t = benefits in each year t

C_t = costs in each year t

n = number of years to end of project

i = discount rate or consumption rate of interest (CRI)

ERR = the internal economic rate of return

Based on the provided equations, there is a relationship between NPV and ERR. When NPV equals 0 then ERR equals *i*, that is ERR is equal to the consumption rate of interest (or the discount rate used in calculating the NPV). Both presented measures provide the answer about economic efficiency for the project. In addition, the social areas of the projects such as employment, indirect (labor) market, legal aspects, education, et cetera can be considered, monetized, and the calculated value can be added to the market benefits. The NPV is an absolute value or magnitude of the present value of net benefits of a project. It does not give information on how large the cost will be to achieve the NPV.

Implementation of NPV for forest projects implies the passive commitment from management to strategy of investment. Since the most of the forest projects have long time horizons, inability using the NPV method to calculate properly the future cash flows poses serious challenges (Regan, Bryan, Connor, Meyer, Ostendorf, Zhu & Bao, 2015).

The risk and uncertainty of future cash flows of forest projects has a major negative impact on management decision. Means, that there is uncertainty yearly income from main product of the forest, timber, what makes the forest project less attractive for investment. That is why, investment valuation is one of the main aspects we need to focus on.

There is a curtain structure I want to develop in my work. In order to make the investors attracted to the forest investments projects we need to show the benefits they can get from selling the timber. One of the possibilities is to forecast the price of the timber and use the financial options.

There are two types of financial options: put options and call options. An option provides the right, but not the obligation, to buy (call option) or sell (put option) an underlying asset at a fixed price by a certain specified time in the future. A call option is a

security which gives the rights to buyer to “call away” the specific numbers of shares of assets from seller on agreed, exercise price at any time until the expiration time. The put option is the reverse of call option, which allows buyer to sell an asset at a specified price until expiration (Hughes, 2000).

Since we are talking about forest, the profitability of forestry projects can be determined based on the future cash flow assumptions. Since investments decision related forest characterized by relatively large sunk of costs together with risks and uncertainties in production and prices it is very crucial to have proper management strategy (Duku-Kaakyire & Nanang, 2004). The working processes related call options has to be also clear and structured accordingly. We need to make contracts between three sides. First is the contract between Non-Government organizations and beneficiaries (farmers who works with forest), the second is the contract (based on the put and call options) between the non –government organizations and investors. Since we are talking about investments in nature conservation projects, for example, forest investment projects, it is very difficult to make a financial decision. The positive outcomes in such programs assume to be gained after a long period of time, which makes it uncertain in terms of financial return. In this case, the managers have to consolidate the uncertainty into the decision-making process. There is a range of different models and approaches that were developed to take into account uncertainty. The real options approaches provide the possibility to value managerial flexibility, such as options to wait (or delay), option to resign and other managerial strategic options (Duku-Kaakyire & Nanang, 2004). The real-options method proposes an approach for uncertainty that is commonly based on financial options. The estimation of future development of underlying assets is required to be able to determine

the value of the financial option. One of the most common models is the time-continuous Black–Scholes-model. The calculation of this model is based on assumptions of possibility having a riskless hedged position. It can be done by quantifying the potential outcomes by knowing the level of the potential risk. This is the reason why we change probability distributions to make a risk-averse investor risk-neutral. The main assumption of Black–Scholes-model is a log normal distribution of future payoffs. The partial differential equation (PDE) with *T* is used in the model to determine the option value. The PDE can be solved to the continuous time Black–Scholes-formula for a call option (without dividends). The formula can be presented as follows:

$$C = SN(d1) - Xe^{-rT}N(d2) \tag{3}$$

Where $N(\cdot)$ standard normal distribution function

$$d1 = \frac{\ln\left(\frac{S}{X}\right)+\left(r+\frac{\sigma 2}{2}\right)T}{\sigma\sqrt{T}}$$

$$d2 = d1 - \sigma\sqrt{T}$$

Where *r* is the continuously compounded risk−free rate.

The terms $N(d1)$ and $N(d2)$ are the cumulative probability for a unit normal variable *z*, and r_f is the risk-free interest rate.

The above mentioned model of real option helps to identify "potential sources of value within the real project" which is difficult to do with models such as net present value calculations. For more details, refer to reference (Hildebrandt & Knoke, 2011).

There are following inputs to the Black-Scholes formula: C- call option value, S, the current price of the stock; X, the strike price of the option; σ, the volatility of the stock; r, the continuously compounded risk-free interest rate; T, the time to expiration of contract. N(x) in the Black-Scholes formula is the cumulative normal distribution function, which is the probability that a number randomly drawn from a standard normal distribution (i.e., a normal distribution with mean 0 and variance 1) will be less than x.

While we are working with call option, there is a problem in determining the value of an American option with stochastic cash flows C before time t and with optimal stopping rule for all $s \in (t, T]$.

Generally speaking, an American option can be exercised any time before the expiration date. Talking more precisely, there is a range where the American option can only be executed at the K discrete times $0 < t_1 < t_2 < \cdots < t_K = T$.

It is reasonable, that American option is exercisable well when K is adequately large. At the expiration date $t_K = T$, the option-holder either exercises the option if it is in-the-money or lets it expire otherwise. Before that, at time t_k, $k = 1, 2, \ldots, K-1$, the option-holder will decide whether to exercise the option right away or hold on to make the decision one time period later at $tk+1$. The option value is maximized unconditionally if it is exercised whenever the immediate exercise value exceeds the continuation value (Duffie, 2001).

One of the core problems is to find the optimal exercise time for the forest option. If we will assume the well-functioning markets with no risk for price jumps it will never pay to exercise an American call option on no dividend paying stocks before expiration. We can conclude it based on the fact that the owner of the option will always be better off either selling the option in the market, or just waiting. But in case of forest option it is

different in two reasons. The first one is that there is yield from owning a forest, and second one is the forester will get a new option, when the previous one is exercised.

The Black-Scholes model is based on the assumption that on the market with continuous trading opportunities there is possibility to develop a risk-free hedge portfolio which will include a long position in the stock timber and a short position in the call written on that stock timber. In case when the price will change, it is possible to maintain the risk-free hedge by readjusting the proportion of stocks and calls.

The BSM is based on the assumption of having market with continuous trading opportunities and possibilities of forming the risk-free hedge portfolio with "long position of stock(timber) and short position in the call on that stock (timber)." Meaning that whenever the stock (timber) price changes, the proportion of stocks and calls can maintain the risk-free hedge and calls.

Mentioning again two ways to exercise the options, American and European, the main difference between them is that American option gives the holder the right to select the time at which to exercise the option, while a European option may be exercised only at a fixed date. It is better to use the American call or put option while considering the investment in land use, because it can be exercised any time (Regan, Bryan, Connor, Meyer, Ostendorf, Zhu & Bao, 2015). The Blacke-Scholese-Merton (BSM) model represents the partial differential equation which allows calculation of large number of values of option in short period of time. The equation has some limitations. Initially it was designed for financial derivatives and not for complicated options. The only one source of uncertainty is applicable under BSM model, while the forest land investment projects are

considered to have several sources of uncertainty and have highly importance in in determining the returns.

In order to make it more applicable for management decision regarding complex uncertainty problems of real options, it is necessary to simplify the assumptions. If we will talk about particular model, Black–Scholes-model (BSM), it is more applicable for European style option, because it assumes that options can be exercised in certain maturity date. So BSM model has an advantage of calculating of a large number of option values in short time.

Thus the other method which allows to solve the investment problems related to multiple uncertainties and long time frames is simulation. It calculates an option value by randomly simulating the huge number of possible future scenarios for variables which are uncertain. The most popular and common method of simulation is Monte Carlo (Mun, 2006).

Chapter 6: Appropriate Model

6.1 Simulation

The main problem for valuation option is coverage of many stochastic factors. One of the possible solution could be the simulation. The common used simulation method is Monte Carlo Simulation, which considers the calculation of the expected present value of the payoff of a call option on a stock. We can assume that *S(t)* is the price of the stock at time *t*. Considering the case when a call option gives the holder the right to buy the stock at a fixed price *K* at a fixed time *T* in the future; the current time *is t = 0.* If at time *T* the stock price *S(T)* exceeds the strike price *K*, the holder exercises the option for a profit of $S(T) - K$; if, on the other hand, $S(T) \leq K$, the option expires worthless.(This is a European option, as was described before, it means that it can be exercised only at the fixed date T, while in American option the holder to choose the time of exercise.)

The payoff to the option holder at time T can be presented such as:

$(S(T) - K)+ = \max\{0, S(T) - K\}$.

In order to get the present value of currents payoff we need to multiply by a discount factor

e^{-rT}

with *r* as continuously compounded interest rate. The expected present value can be defined as $E[e^{-rT} (S(T) - K)+]$.

To make it more reasonable the distribution of the random variable *S(T)* has to be specified. It is useful for the dynamics of the stock price. There is a need to form the sequences *Zi* of independent standard normal random variables and the following algorithm can be used:

for $i = 1, \ldots, n$

generate *Zi*

set $Si(T) = S(0) \exp([r - \frac{1}{2}\sigma^2]T + \sigma\sqrt{T}Zi)$

set $Ci = e^{-rT}(S(T) - K)^+$

set $\hat{C}_n = (C_1 + \cdots + C_n)/n$

For any $n \geq 1$, the estimator $\hat{C}_n$ is *unbiased*, in the sense that its expectation is the target quantity:

$E[\hat{C}_n] = C \equiv E[e^{-rT}(S(T) - K)+]$.

The estimator is *strongly consistent*, meaning that as $n \to \infty$,

$\hat{C}_n \to C$ with probability 1.

For finite but considerable large *n*, the point estimate $\hat{C}_n$ can be supplemented with a confidence interval.

$$s_C = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(c_i - \hat{c}_n)^2}$$

We can define the sample standard deviation of *C*1, . . ., *Cn* and let $z\delta$ denote the $1-\delta$ quantile of the standard normal distribution (i.e., $\Phi(z\delta) = 1 - \delta$). We will get

$$\hat{C}_n \pm z_{\delta}/_2 \frac{S_C}{\sqrt{n}}$$

as n → ∞, valid $1 - \delta$ *with* confidence interval for *C*. (For a 95% confidence interval, δ = .05 and $z\delta/2 \approx 1.96$.) Since the standard deviation is usually estimated parameter, $z\delta/2$ can be replaced with the corresponding quantile from the t distribution with n−1 degrees of freedom, which results in a slightly wider interval. In either case, the probability that the interval covers C approaches 1−δ as n→∞ (Glasserman, 2003).

Before making financial decision about investment, Non-Government organizations (NGO) as intermediaries can sell options to investors and eliminate the risk from the resulting short position in the option through trading in other assets.

They need to charge it costs to implement the trading strategy, based on the competition, not more than that. The investors can use the replicating trading strategy themselves instead of buying options. But since, NGO as a financial institution is usually has an expertise to do this and can do it at lower cost. In addition, there is an involvement of the insurance industry can also play role. Insurers bear risk; derivative dealers transfer it. In order to risks to be perfectly hedged, the market supposed to be complete.

In terms of NGO, it has to determine which structure to take in order to hedge the security by trading in other, more liquid assets, and in addition, the cost of this trading strategy from the prices of these other assets has to be determined as well. In term of other assets, the other products from like coffee or other forest production can be used.

The particular method of simulation to evaluate the timber harvest contracts which going to be used in current paper is Least –squares Monte Carlo simulation (LSM). First this algorithm was presented by Longstaff and Schwartz (2001), as a technic for the American option. The main idea of LSM approach is using of least squares to estimate the expected payoff for the option. The flexibility of price behavior related to choice of stochastic model makes the LSM more attractive than traditional "finite difference techniques". American option is considered to be the most difficult to calculate, because there is more than one factor which affect the value of the option. As a simple explanation of current technic in terms of American option, we can say that, it is simulation by least squares which allows to estimate the conditional expectation of the payoffs from

continuing to keep the option in action. By other words, there is a regression of the ex post realized payoffs from the values of the state variables. The value which we will get from regression is an estimation of the conditional expectation function which can be defined for each exercise date. By this way can get the most appropriate exercise strategy for the whole duration of American option contract. The only requirement for this approach is simple least squares.

The optimal strategy of the current approach is to compare the instant exercise value with value of expected cash flows and then exercise in case if immediate exercise is more valuable. In order to identify the conditional expectation function, we need to use the cross-sectional information in the simulated paths (Longstaff and Schwartz, 2001).

The timber harvest contract terms can be defined based on scale sale (in tons), length of the contract. When two parties agreed upon the conditions for the contract, it is a starting point for the standing timber volume.

One of the main focus in current research paper is to implementation of the methodology which is applicable to value of the scale sale harvest contract. The value of a harvest contract with stochastic timber prices can be considered as expected cash flow as well as discounted profit from the forest yields at the optimal time.

6.2 Implementation of Monte Carlo and Results

Based on information from different research papers the main task of Monte Carlo simulation-based approaches in is to solve the problem of pricing American-style derivatives. While in current paper the Monte Carlo methods to American option pricing problems was implemented, more particular, the Least Squares Monte Carlo method used as more suitable method for higher dimensions' problems. Using this method, we would

like to generate the pricing data of forest asset at any exercise time. This will allow the holder of an American option to exercise the contract with higher value. More particular, we used the LSM method in simulation (The data taken from Longstaff & Schwartz, 2001). Using the different values of variables, we regressed the option payoffs. The values which were obtained by regression provides the expectation function which is conditional. By the simulation we could estimate the conditional expectation of value for exercise date. In our test we use the American put option. There is a reason, why we decided to use American put options.

Since we are using the optimal strategy, it is not optimal to exercise an American call option before the expiry date. A call option defines as option to buy the underlying asset by a certain expiry date as well as for a certain price (the strike price). While put option provides the right to sell the underlying asset at the strike price which was agreed before the expiry date. Since, as was mentioned, it is not optimal to exercise an American option before the expiry date, we decided that it is better to choose and analyze American put options.

Now we can start the process of analysis. We will define *S(t)* as asset price at time *t* and *K* is defined as exercise price. We assume that no dividends are paid. The exercising price is 1.10 and there are three possible dates of exercising. When we consider that 3 times, we consider that the last time (expiration date of the option). We assumed that the riskless rate is equal to 0.06. The provided measurement is considered the risk-neutrality. The general definition of risk-neutral measure is that it is a probability measure that makes an investment return at the risk-free rate (the process and initial assumption of data was used from Longstaff & Schwartz , 2001).

As a sample we use algorithm with seven paths for the price of the stock. For calculation we used the initial price of assets as 1.0 and as was mentioned before, exercising price as 1.1, riskless rate 0.06 (assumption). In addition, in order to simulate the data, we assumed different rate of volatilities as well. The results which were obtained by using the simulation and LSM techniques are presented in the table below. All the calculations were performed using MATLAB tool.

Table:

Path	Stock price path			
	t = 0	t = 1	t = 2	t = 3
1	1.000	1.0906	1.0940	1.0941
2	1.000	1.1218	1.1369	1.1384
3	1.000	1.2051	1.2534	1.2694
4	1.000	1.0686	1.0687	1.0688
5	1.000	1.1060	1.1143	1.1148
6	1.000	1.1373	1.1587	1.1633
7	1.000	1.0877	1.0899	1.0901

Our task is to find the maximum value of the option at each point along each path. But before that we will calculate the intermediate matrices. The table below shows, expected cash flows. It will give idea to holder about exercising the contract before final expiration date.

Path	Cash flow matrix for time 3		
	t = 1	t = 2	t = 3
1	–	–	0.000
2	–	–	0.000
3	–	–	0.001
4	–	–	0.000
5	–	–	0.000
6	–	–	0.000
7	–	–	0.000

Depending on value which we will get for time 2 and time 3 the option holder has to decide whether to exercise the option immediately or continue to wait until the optimal maximum value. We can calculate the conditional expectation function and compare value of immediate exercise (for more detailed information refer to Longstaff & Schwartz, 2001) at time 2 with the value from continuation. The table below shows the results.

Path	Optimal early exercise decision at time 2	
	Exercise	Continuation
1	0.059	0.023
2	–	–
3	–	–
4	0.313	0.473
5	–	–
6	–	–

7	0.026	0.027

Exercise price was found by subtracting the stock price, which we can denote as X from the initial exercise price, which is equal to 1.10. In order to find the continuous price, we did use the following conditional expectation function:

$E[\ Y \mid X\ ] = -1.070 + 2.983X - 1\ .813X^2$

This comparison indicates that it is optimal to exercise the option at time 2 for the first path only. This present the following matrix, which shows the cash flows which holder of option has as a conditional to not exercising before time 2.

Path	Cash flow matrix for time 2		
	t = 1	t = 2	t = 3
1	_	0.059	0.000
2	_	0.000	0.000
3	_	0.000	0.010
4	_	0.000	0.000
5	_	0.000	0.000
6	_	0.000	0.000
7	_	0.000	0.000

It is important to remember that when the option is exercised at time 2, the cash flow for time 3 (in the last column becomes zero). This is because when the option is exercised once, it means that there are no other further cash flows, because the option can be exercised only once.

Now we need to check whether the option could be exercised at time 1.

For the time 1, we will use the following conditional expectation function:

$E[\ Y \mid X\ ] = 2.038 - 3.335X + 1.356X^2$

Path	Optimal early exercise decision at time 1	
	Exercise	Continuation
1	0.099	0.275
2	–	–
3	–	–
4	0.313	0.275
5	–	–
6	–	–
7	0.329	0.260

By comparing two columns we can see that exercise at time 1 is optimal for the fourth and seventh paths.

As was mentioned before, the option can be exercised only once, means the future cash flows will occur at only time 2 or 3, but not both of them. Cash flows which will be obtained at time 2 are discounted back one period to time 1, and the same for time 3. By other words, the cash flows which will be received at time 3will be discounted back two periods to time 1.

When we are done with our comparison, there is time to implement "stopping rule" (Longstaff & Schwartz, 2001). By defining the exercise strategy, we will come up with matrix, which show the which dates and option when it can be exercised.

Path	Stopping rule		
	t = 1	t = 2	t = 3
1	0	0	0
2	0	0	0
3	0	0	1
4	1	0	0
5	0	0	0
6	0	0	0
7	1	0	0

Now when we determined the structure of working with stopping rule, we can find the cash flows with accordance of stopping rule. It is possible to implement it by exercising the option at the exercising dates with one in the matrix (means the value is bigger). By using this method, we will come out with following option cash flow matrix.

Path	Option cash flow matrix		
	t = 1	t = 2	t = 3
1	0	0	0
2	0	0	0
3	0	0	0.01

4	0.313	0	0
5	0	0	0
6	0	0	0
7	0.329	0	0

Based on the cash flow which we got for different dates and paths, we can calculate now the value of the option by discounting each cash in the matrix back to time zero, and averaging over all paths. The final result we got the is equal to 0.0917, which is the value for American put option.

The presented example shows the principle how least squares can be used in order to estimate the conditional expectation function. And from the other side the conditional expectation function is can be used in management decision related the distinguishing value of the option at each date and each path.

Chapter 7: Conclusion and recommendations

Due to globalization and increasing interest in environmental programs, most of the countries now want to improve the management of their forests make it more sustainable. Nevertheless, there are still much of work which have to be done because of a lack in financial support. Many countries currently are using a limited number of approaches and most of the time grants and subsidies used and cover only a few activities.

The main idea of the current thesis work was to highlight the main problem related to forest management and ways to make it more sustainable using different financial approaches. The three main parts of this research which have been investigated are:

1. forest issues along with their respective solutions,
2. financial investment as an operational tool, and
3. financial mechanisms for sustainable forestry.

The first three chapters of thesis discovered the main problems of forest management and based on the analysis of different research papers presented some optional solutions together with options for different stakeholders. The second part of the research paper was covered by chapter four. Specifically, what is the role of financial investment in forest management strategy and what financial options are available to make the forest projects more sustainable. The last and main part which covered by chapters five and six describes the theoretical framework of the different financial methodologies applicable as general tools for nature conservation as well as some particular real option methodologies which applicable for specificity of forest projects. Due to the specificity of forest projects it is very important to define the proper financial methodology which can become as a key tool for forest projects management during the making the decision related to forest assets. This

work is provided one of the simulation methods, Monte Carlo Simulation, which considers the calculation of the expected present value of the payoff of a call option on a stock, more particular, the Least Squares Monte Carlo method. The main idea was to describe the possible available financial solutions which could simplify the complicated processes for management. The Matlab program allowed to calculate the option values for timber using the LMC algorithm. Two resources papers such as: "Valuing American Options by Simulation: A Simple Least-Squares Approach" by Longstaff, & Schwartz (2001), as well as "Pricing American Options using Monte Carlo Methods" by Jia (2009) were used as a main resource to describe the methodology and in provision of example. The "Stopping rule" which can be used for management decision is used as one of the possible options. This study is a framework on financial investment management on sustainability, which could be tailored as a guidance and overview for the future deeper research dissertation on related topics.

References

Adams J.S &Victurine, J. S. (2011). Permanent Conservation Trusts-A study of long-term benefits of conservation endowments.

retrieved from: http://www.dcnanature.org/wp-content/uploads/fundraising/Permanent-Conservation- Endowments.pdf

Alliance-CFA, C. F. (2013). Comparative advantages of Conservation Trust Funds and Project Approach to support Protected Areas.

Avramidis, A. N., & L'Ecuyer, P. (2006). Efficient Monte Carlo and quasi-Monte Carlo option pricing under the variance gamma model. *Management Science*, *52*(12), 1930-1944

Asian Development Bank (2012) Public–Private Partnership Operational Plan 2012–2020.

retrieved from: http://www.adb.org/sites/default/files/institutional-document/33671/ppp-operational-plan-2012-2020.pdf

Assefa, E., & Bork, H. R. (2014). Deforestation and forest management in Southern Ethiopia: investigations in the Chencha and Arbaminch areas. *Environmental management*, *53*(2), 284-299.

Briand, N., & Carret, P. (2012). CEPF and Conservation Trust Funds.

retrieved from: http://www.cepf.net/SiteCollectionDocuments/monitoring/CEPF_soutien_aux_FFC_EN.pdf

Bayon, R., Deere, C., Norris, R., & Smith, S. E. (1999). Environmental funds: lessons learned and future prospects. *Washington DC: GEF and IUCN*.

retrieved from: https://www.cbd.int/financial/trustfunds/g-fundlessons.pdf

Briand, N., & Carret, P. (2012). CEPF and Conservation Trust Funds.

retrieved from:
http://www.cepf.net/SiteCollectionDocuments/monitoring/CEPF_soutien_aux_FFC_EN.pdf

Brancalion, P.H.S., Viani, R.A.G., Strassburg, B.B.N. & Rodrigues, R.R**. (**2012). Finding the money for tropical forest restoration. *Unasylva*, 63(239): 25–34. retrieved from: http://www.landscapes.org/wp-content/uploads/2013/10/Brancalion-Strassburg.pdf

Boyle, P. P. (1977). Options: A monte carlo approach. *Journal of financial economics, 4*(3), 323-338.retrieved from: http://194.145.208.139/ANTI/ADMXI/documentation/ALGORITHM_DOCUMENTATION/HEIDIX/FINANCIAL_ECONOMETRICS/MONTE_CARLO/1976_Options_A_Monte_Carlo_Approach.pdf

Boyle, P. P., Kolkiewicz, A. W., & Tan, K. S. (2003). An improved simulation method for pricing high-dimensional American derivatives. *Mathematics and Computers in Simulation, 62*(3), 315-322. retrieved from: https://www.semanticscholar.org/paper/An-improved-simulation-method-for-pricing-high-Boyle-Kolkiewicz/9d03d49490d960ced9241e274ab108b5ec64fd29/pdf

Broadie, M., & Glasserman, P. (2004). A stochastic mesh method for pricing high dimensional American options. *Journal of Computational Finance, 7*, 35-72. retrieved from: https://www.semanticscholar.org/paper/A-stochastic-mesh-method-for-pricing-high-Broadie-Glasserman/00ff5a1157d03662e8090c9ea906aa4daee3a3ee/pdf

Birdsey, R., & Pan, Y. (2015). Trends in management of the world's forests and impacts on carbon stocks. Forest Ecology and Management, 355, 83-90. retrieved

from: http://www.fs.fed.us/nrs/pubs/jrnl/2015/nrs_2015_birdsey_001.pdfCosta, K., Shah, S., & Ungar, S., 2012, Frequently Asked Questions: Social Impact Bonds. Washington: Center for American Progress. retrieved from: https://www.americanprogress.org/wp-ontent/uploads/2012/12/FAQSocialImpactBonds-1.pdf

Cortazar, G., Gravet, M., & Urzua, J. (2008). The valuation of multidimensional American real options using the LSM simulation method.*Computers & Operations Research*, *35*(1), 113-129. retrieved from: http://gonzalocortazar.com/CortazarGravetUrzua2008.pdf

Cunha, M. R., & Fontes, D. B. (2005). A Real Options Approach to the Valuation of an Investment in Eucalyptus. *9th Real Options; Theory Meets Practice*. retrieved from: https://repositorio-aberto.up.pt/bitstream/10216/70683/2/16189.pdf

Cubbage, F., Davis, R., Frey, G., & Behr, D. C. (2013). Financial and economic evaluation guidelines for community forestry projects in Latin America. *Program on Forests (PROFOR), Washington, DC*. retrieved from: http://www.profor.info/sites/profor.info/files/docs/Financial%20and%20Economic%20Evaluation%20Guidelines%20for%20Community%20Forestry%20Projects%20in%20Latin%20America_0.pdf

Costa, K., & Shah, S. (2013). Government's role in pay for success. *Community Development Investment Review*, (01), 091-096.

Conservation Finance Alliance Guide: retrieved from :http://www.conservationfinance.org

Chandrasekharan Behr, D. (2012). Making Benefit Sharing Arrangements Work for Forest-dependent Communities: Overview of Insights for REDD+ Initiatives.

Council, G. E. F. (1998). GEF Evaluation OF Experience WITH Conservation Trust Funds. retrieved from: https://www.cbd.int/financial/trustfunds/g-gefevaluation.pdf

Duffie D. (2001). Dynamic Asset Pricing Theory, Princeton University Press, Princeton, NJ. retrieved from: http://lib.cufe.edu.cn/upload_files/file/20140522/3_20140522_9-Dynamic%20Asset%20Pricing%20Theory(Duffie).pdf

Duku-Kaakyire, A., & Nanang, D. M. (2004). Application of real options theory to forestry investment analysis. *Forest Policy and Economics*, *6*(6), 539-552.

Doherty, B., H. Haugh, and F. Lyon. 2014. "Social Enterprises as Hybrid Organizations: A Review and Research Agenda." *International Journal of Management Reviews 16 (4): 417–36.*

Dixit, A. K., & Pindyck, R. S. (1995). The options approach to capital investment. *Real Options and Investment under Uncertainty-classical Readings and Recent Contributions. MIT Press, Cambridge*, 6.

Food and Agriculture Organization (2015). Sustainable financing for forest and landscape restoration. retrieved from: http://www.fao.org/3/a-i5032e.pdf

Food and Agriculture Organization (2008). Financing sustainable forest management retrieved from: http://www.fao.org/documents/card/en/c/44d2af41-951e-4bfc-958c-3d491e335ee3/

Freireich, J., & Fulton, K. (2009). Investing for social and environmental impact: A design for catalyzing an emerging industry. *Monitor Institute*, *January*. retrieved from: http://www.monitorinstitute.com/downloads/what-we-think/impact-investing/Impact_Investing.pdf

Gregersen, H., Contreras, A., Campos Arce, J.J., Finegan, B., Camacho, M., Quirós, D., Trejos, S. & Platen, H.V. (1995). *Economic assessment of forestry project impacts*. Evaluación económica de las repercusiones de los proyectos forestales (No. FAO FP-106). Food and Agriculture Organization, Roma (Italia).

Gjolberg, O., & Guttormsen, A. G. (2002). Real options in the forest: what if prices are mean-reverting? *Forest Policy and Economics*, 4(1), 13-20.

Glasserman, P. (2003). *Monte Carlo methods in financial engineering* (Vol. 53). Springer Science & Business Media.

Geobey, S., Westley, F. R., & Weber, O. (2012). Enabling social innovation through developmental social finance. *Journal of Social Entrepreneurship*,*3*(2), 151-165.

Gilbert, E. (2004). Investment Basics XLIX. An introduction to real options. *Investment Analysts Journal*, *33*(60), 49-52.

Guerin-McManus, M. (2001). Conservation Trust Funds. *UCLA J. Envtl. L. & Pol'y*, 20, 1. retrieved from: http://escholarship.org/uc/item/3476614r

Horowitz B. (2008) Monte Carlo Analysis retrieved from: http://iwstrategists.com/_uploads/monte%20carlo.pdf

Hughes, R. (2000). Valuing a forest as a call option: The sale of Forestry Corporation of New Zealand. *Forest science*, *46*(1), 32-39.

Hildebrandt, P., & Knoke, T. (2011). Investment decisions under uncertainty—a methodological review on forest science studies. *Forest Policy and Economics*, 13(1), 1-15.

Huwyler, F., Käppeli, J., Serafimova, K., Swanson, E., & Tobin, J. (2014). Conservation Finance: Moving beyond Donor Funding toward an Investor-Driven Approach. *Credit Suisse, WWF, McKinsey & Company: Zurich, Switzerland*.

Houghton, R. A., Werf, G. V. D., DeFries, R. S., Hansen, M. C., House, J. I., Quéré, C. L., ... & Ramankutty, N. (2012). Chapter G2 Carbon emissions from land use and land-cover change. Biogeosciences Discussions, 9(1), 835. retrieved from: http://whrc.org/wp-content/uploads/2015/09/HoughtonetalBiogeoSciDiscuss.12.pdf

Jia, Q. (2009). Pricing American Options using Monte Carlo Methods. *Department of Mathematics, Uppsala University*.

Köhl, M., Lasco, R., Cifuentes, M., Jonsson, Ö., Korhonen, K. T., Mundhenk, P., ... & Stinson, G. (2015).Changes in forest production, biomass and carbon: Results from the 2015 UN FAO Global Forest Resource Assessment. *Forest Ecology and Management*, *352*, 21-34. http://www.fao.org/3/a-i4895e/i4895e03.pdf

Kohli, J., Besharov, D. J., & Costa, K. (2012). Social impact bonds 101-Defining an innovative new financing tool for social programs. *Center for American Progress*.

Danish, K. W. (1995). International Environmental Law and the" Bottom-Up" Approach: A Review of the Desertification Convention. *Indiana Journal of Global Legal Studies*, 133-176.

Meade, R. B., Fiuza, G., Lu, A., Boyle, G. W., & Evans, L. T. (2008). *Forest and forest land valuation: How to value forests and forest land to include carbon costs and benefits*. Ministry of Agriculture and Forestry.

retrieved from: http://maxa.maf.govt.nz/climatechange/slm/grants/research/2007-08/2008-05-summary.htm

Longstaff, F. A., & Schwartz, E. S. (2001). Valuing American options by simulation: a simple least-squares approach. *Review of Financial studies*,*14*(1), 113-147. retrieved from: https://people.math.ethz.ch/~hjfurrer/teaching/LongstaffSchwartzAmericanOptionsLeastSquareMonteCarlo.pdf

Lambert, A. (2006). Sustainable Financing for Environmental Projects in Africa: Some Ideas for Consideration. *Brazzaville, Congo*.

MacDicken, K. G., Sola, P., Hall, J. E., Sabogal, C., Tadoum, M., & de Wasseige, C. (2015). Global progress toward sustainable forest management. *Forest Ecology and Management*, *352*, 47-56.

Mei, B., & Clutter, M. L. (2013). VALUING A TIMBER HARVEST CONTRACT AS A HIGH-DIMENSIONAL AMERICAN CALL OPTION VIA LEAST-SQUARES MONTE CARLO SIMULATION. *Natural Resource Modeling*, 26(1), 111-129.

McGuire, D**.** 2014. FAO' s Forest and Landscape Restoration Mechanism. *In* J. Chavez-Tafur & J. Roderick Zagt, eds. *Towards productive landscapes*. Wageningen, Netherlands, Tropenbos International.

Mun, J. (2006). Modeling risk: applying Monte Carlo simulation, real options analysis, forecasting, and optimization techniques (Vol. 347). John Wiley & Sons.

Munang, R. (2011). Sustaining Forests: Investing in our common future. retrieved from: http://sd.iisd.org/news/unep-issues-policy-brief-on-the-role-of-forests-in-a-green-economy/

Miller, L. T., & Park, C. S. (2002). Decision making under uncertainty—real options to the rescue. *The engineering economist*, *47*(2), 105-150.

retrieved from: https://www.researchgate.net/publication/247505204_Decision_Making_Under_Uncertainty-Real_Options_to_the_Rescue

Mikitin, K., & Osgood, D. (1995). *Issues and options in the design of GEF supported trust funds for biodiversity conservation* (Vol. 11). Washington, DC: Environment Department, World Bank.

retrieved from: https://www.cbd.int/financial/trustfunds/g-fundissues-gef.pdf

Munang, R. T., Thiaw, I., & Rivington, M. (2011). Ecosystem management: Tomorrow's approach to enhancing food security under a changing climate. Sustainability, 3(7), 937-954.

Nicola J. D. (2013) Environmental Impact Bonds:

retrieved from: http://sites.duke.edu/casei3/files/2013/03/CASEi3_EIB_Report_FINAL-links.pdf

Nature Vest. (2014). Investing in Conservation

retrieved from:http://www.naturevesttnc.org/pdf/InvestingInConservation_Report.pdf

Nicholls, A. (2010). The institutionalization of social investment: The interplay of investment logics and investor rationalities. *Journal of social entrepreneurship*, *1*(1), 70-100.

Pažek, K., & Rozman, Č. (2011). Business opportunity assessment in Slovene organic spelt processing: application of real options model. *Renewable agriculture and food systems*, *26*(03), 179-184.

Petrasek, S., & Perez-Garcia, J. M. (2010). Valuation of Timber Harvest Contracts as American Call Options with Modified Least-Squares Monte Carlo Algorithm. *Forest Science*, *56*(5), 494-504.

Patton, M.Q. (2011). *Developmental evaluation: applying complexity concepts to enhance innovation and use.*New York: The Guilford Press.

Pan, Y., Birdsey, R. A., Phillips, O. L., & Jackson, R. B. (2013). The structure, distribution, and biomass of the world's forests. Annual Review of Ecology, Evolution, and Systematics, 44, 593-622.

Regan, C. M., Bryan, B. A., Connor, J. D., Meyer, W. S., Ostendorf, B., Zhu, Z., & Bao, C. (2015). Real options analysis for land use management: Methods, application, and implications for policy. *Journal of environmental management*, *161*, 144-152.

Sloan, S., & Sayer, J. A. (2015). Forest Resources Assessment of 2015 shows positive global trends but forest loss and degradation persist in poor tropical countries. *Forest Ecology and Management*, *352*, 134-145.

Shames, S., Clarvis, M., & Kissinger, G. (2014). Financing Strategies for Integrated Landscape Investment: Synthesis Report. *Financing Strategies for Integrated Landscape Investment*.

retrieved from: http://www.un.org/esa/ffd/wcontent/uploads/sites/2/2015/10/FinancingStrategiesforIntegratedLandscapeInvestment_Shames_etal_2014-smaller.pdf

Stentoft, L. (2004). Convergence of the least squares Monte Carlo approach to American option valuation. *Management Science*, *50*(9), 1193-1203.

retrieved from: https://www.semanticscholar.org/paper/Convergence-of-the-Least-Squares-Monte-Carlo-Stentoft/80f0669c477efc83d57e0272c8cb5da5461c5992/pdf

Secretariat, G. E. F. (1998). Evaluation of Experience with Conservation Trust Funds. Global Environment Facility, Monitoring and Evaluation Team. New York.
retrieved from: https://www.cbd.int/financial/trustfunds/g-gefevaluation.pdf

Tetsuya, T., & Shunsuke, M. (2011). *The Effect of Trade Openness on Deforestation: Empirical Analysis for 142 Countries* (No. 35805). University Library of Munich, Germany. https://mpra.ub.uni-muenchen.de/35805/1/Deforestation_tsurumimanagi.pdf

Tubetov, D., Musshoff, O., & Kellner, U. (2012). Investments in Kazakhstani dairy farming: a comparison of classical investment theory and the real options approach. *Quarterly Journal of International Agriculture*, *51*(3), 257.
retrieved from: http://ageconsearch.umn.edu/bitstream/155480/2/4_Tubetov.pdf

Trigeorgis, L. (1996). *Real options: Managerial flexibility and strategy in resource allocation*. MIT press.

Triantis, A. J. (2003). *Real Options, Handbook of Modern Finance* (Doctoral dissertation, ed. D. Logue and J. Seward, Research Institute of America, New York).

United Nations (1992). The Rio Declaration and Agenda 21. New York, NY.

Victurine, J. S. (2011). Permanent Conservation Trusts-A study of long-term benefits of conservation endowments.

The World Resources Institute & the World Business Council for Sustainable Development (2005). Sustainable Forest Management.
retrieved from: http://www.sustainableforestprods.org/Sustainable_Forest_Management

Warner, M. E. (2013). Private finance for public goods: social impact bonds. *Journal of Economic Policy Reform*, 16(4), 303-319.

Yeo, K. T., & Qiu, F. (2003). The value of management flexibility—a real option approach to investment evaluation. *International Journal of Project Management*, *21*(4), 243-250.

Appendix: Matlab codes (modified from reference: Jia (2009))

```
close all;
clear all;
clc;

sigma = 0.09;
S0 = 1;
r = 0.06;
D = 0;
T = 1;
KP = 1.1;

dt = 1/7;
N = T/dt;
NSim = 10000;

dBt = sqrt(dt)*randn(NSim,N);
St = zeros(NSim,N);
St(:,1) = S0*ones(NSim,1);

x = 1.0899;

for t = 2:N;

   St(:,t) = St(:,t-1)*exp(r-D-0.5*sigma^2)*dt + sigma*dBt(:,t);

end

SSit = St;
NSim = size(SSit,1);

MM = NaN*ones(NSim,N);
MM(:,N) = max(KP - SSit(:,N),0);

for tt = N:-1:3;

   I = find(KP - SSit(:,tt - 1)>0);
   ISize = length(I);

   if tt == N
      YY = (ones(ISize,1).*exp(-r.*[1:N-tt+1].*dt)).*MM(I,tt:N);
```

```
   else
      YY = sum(((ones(ISize,1)*exp(-r*[1:N-tt+1]*dt)).*MM(I,tt:N))')';
   end


SSb = SSit(I,tt-1);
XX = [ones(ISize,1),SSb,SSb.^2,SSb.^3]; % Resultant of
ones(ISize,1),SSb,SSb.^2,SSb.^3
BB = inv(XX'*XX)*XX'*YY;

SSb2 = SSit(:,tt-1);
XX2 = [ones(NSim,1),SSb2,SSb2.^2,SSb2.^3];

IStop = find(KP-SSit(:,tt-1)>=max(XX2*BB,0));
ICon = setdiff([1:NSim],IStop);

MM(IStop,tt-1) = KP - SSit(IStop,tt-1);
MM(IStop,tt:N) = zeros(length(IStop),N-tt+1);

MM(ICon,tt-1) = zeros(length(ICon),1);

end

YY = sum(((ones(NSim,1)*exp(-r*[1:N-1]*dt)).*MM(:,2:N))')';

Value  = mean(YY);
sterr = std(YY)/sqrt(NSim);

 exercise = KP-Value

equation = -1.070 + 2.983*x - 1.813*x^2

d1 = (log(S0/KP) + (r + sigma^2/2)*T)/(sigma*sqrt(T));
d2 = (log(S0/KP) + (r - sigma^2/2)*T)/(sigma*sqrt(T));
P_bseu = KP*exp(-r*T)*normcdf(-d2) - S0*normcdf(-d1)
```