



COLLEGE OF BUSINESS AND ECONOMICS

**CLEANER PRODUCTION AND PROFITABILITY OF TEA FACTORIES
IN RWANDA**

A CASE STUDY OF THREE TEA FACTORIES

By:

Ms. Jackie UWIZEYE

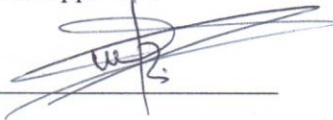
STUDENT No: 218014844

**A Research Project Submitted to the University of Rwanda College of Business
and Economics in Partial Fulfillment for the Requirements for the Award of
Degree of MBA in Project Management**

SEPTEMBER 2019

APPROVAL SHEET

This thesis entitled **CLEANER PRODUCTION AND PROFITABILITY OF TEA FACTORIES IN RWANDA, A CASE STUDY OF THREE TEA FACTORIES (Nyabihu, Mata and Kitabi)** written and submitted by **UWIZEYE Jackie Reg: 218014844** in partial fulfilment of the requirements for the degree of Master's in Business Administration (MBA) at University of Rwanda (UR), College of Business and Economics (CBE), Post Graduate Program Gikondo Campus, is hereby accepted and approved.



Dr. BIGIRIMANA Moise

Supervisor

30/09/2019

The thesis is accepted in partial fulfilment of the requirements for the degree of Master of Business Administration.



Dr. NIYONZIMA Théogène

Member of the Jury

30-09-2019

30/09/2019

Dr. SHEMA Jean Bosco

Member of the Jury

30/09/2019

Dr. KADHAFI

Coordinator of Postgraduate Studies

30/09/2019

DECLARATION

This Project study is my original work and has not been present to any other Institution. No part of this research should be reproduced without the author's consent or that of University of Rwanda.

Students Name: **Jackie UWIZEYE**

Sign _____ Date _____

Declaration by the supervisor(s)

This research study has been submitted with our approval as The University of Rwanda Supervisor.

Names: **Dr BIGIRIMANA Moise**

Sign _____ Date _____

DEDICATION

I dedicate this work

To Almighty God who gave power to handle this work

ACKNOWLEDGEMENT

So many people contributed directly and or indirectly for the success of this work. I would like to thank all people who made it possible for me to carry out this research. Sincerely wish to express my sincere gratitude to my supervisor Dr BIGIRIMANA Moise for his guidance, suggestions, recommendations, encouragements, and authorities. Without him, it would be difficult to achieve my objectives in time. I would like also to thank all the staff of University of Rwanda especially my lectures.

I fully acknowledge the patience and understanding of my family members, especially my parents; and finally to my Classmates for their assistance whether moral and materials rendered to me through this work. I heartily thank them.

Above all, the Almighty God receives the highest appreciation and acknowledgement for sparing my life and for providing me with sufficient energy, time and wisdom to write up this Project.

Thank you God

Thank you all

ABSTRACT

Rwanda as one of environmental and resource utilization strategies needed to overcome such constrains. CP is an opportunity generating strategy, seeking improvements in regards to continuous application of an integrated preventative environmental strategy to processes, products and services to increase efficiency and reduce risks to humans and the environment. The CP implementation objectives are supplemented by eco-efficiency objectives. The main objective of this study is to to evaluate the effect of cleaner production on profitability of selected tea factories in Rwanda. The specific objectives were the following: To evaluate the cost difference between the material used before and after cleaner production to determine the impact of cleaner production on the return on asset of the tea factories, to determine relationship between cleaner production on profitability of the tea factories. The study used a descriptive research design that involved collection of both qualitative and quantitative data. The target population for this study was 30 populations in charge of the Cleaner production project. Research instruments like questionnaire and interview used for data collection and SPSS software analysis was used to analyse data from the field. The results related to the objective, the respondents showed that the cleaner production and environment have a relationship, 76.7% strongly agreed, 16.7% agreed while only 6.6% not agreed. In the table 4.12 and 4.13 the majority of the respondents assumed that cleaner production and profitability in those three tea factories are positively related. The findings of the study showed that the different between the investment and cost saving in three tea factories (Kitabi, Mata and Nyabihu) before and after cleaner production project. Starting on Kitabi tea factory, before CP the total investment made in energy, water, wood and technology was 50,015 UDA and cost saved was 99,143 USD while after CP the factory invested 36,180 USD and saved cost equal to 109,620 USD, it means that after the cleaner production project at Kitabi tea factory has saved more after introducing Cleaner production project in the factory. Before CP the company invested more and saved less which means there is a loss while after CP Kitabi invested less money and saved much money, where the factory profited after CP project, which means that the implementation of cleaner production project in those three tee factories (KITABI, MATA and NYABIHU) contributed more, where each factory after the project implementation has reduced the cost of buying water, energy, wood and technology used and saving more money which have allowed the each factory to save more as profit of the factory.

Key words: Cleaner, Production, Profitability, Tea and Tea Factory.

TABLE OF CONTENTS

DECLARATION	ii
DEDICATION.....	iii
ACKNOWLEDGEMENT	iv
ABSTRACT	v
TABLE OF CONTENTS.....	vi
LIST OF TABLES.....	ix
LIST OF FIGURE	x
LIST OF ACRONYMS AND ABBREVIATIONS.....	xi
CHAPTER ONE.....	1
INTRODUCTION	1
1.1. Background to the Study.....	1
1.2. Statement of the Problem.....	5
1.3. Research Objectives.....	6
1.3.1. Main Objective.....	6
1.3.2. Specific Objectives	6
1.4. Research Questions.....	6
1.5. Research Hypothesis.....	6
1.6. Justification of the research.....	7
1.7. Scope of the research	7
1.7.1. Geographic scope.....	7
1.7.2 Content scope.....	7
1.7.3 Time scope.....	7
1.8. Limitations of the Study.....	7
1.9. Description of the Study	7
CHAPTER TWO.....	9
REVIEW OF LITERATURE	9
2.1. Conceptual review	9
2.1.1. Cleaner production.....	9
2.1.2. Cleaner Production and Sustainable Development.....	10

2.1.3. Cleaner Production Quality and Safety	11
2.1.5. Cleaner Production and Environmental Management System.....	11
2.1.6. Understanding Profitability	12
2.1.7. Reasons for Computing Profitability	12
2.1.8 Ways to Measure the Profitability	13
2.2. Theoretical Review	14
2.2.1 By-product recovery theory	14
2.2.2 Process chemicals and raw materials recycling theory	14
2.2.3 Changing of production processes to reduce waste	14
2.2.4 Waste management theory	15
2.2.5 Raw and process material change theory.....	15
2.2.6 Fresh water management theory.....	16
2.3. Empirical Review	16
2.4. Gap in Literature	18
2.4. Conceptual Framework	21
CHAPTER THREE	22
METHODOLOGY	22
3.1. Research Design	22
3.2. Population of the study	22
3.2.1. Sample Design	22
3.3. Data Collection Instruments	23
3.3.1. Interview	23
3.3.2. Questionnaires.....	24
3.4. Administration of Data Collection Instruments.....	24
3.5. Reliability and Validity	24
3.6. Data Analysis Procedures	24
3.8 Ethical Consideration.....	25
CHAPTER FOUR	26
DATA ANALYSIS AND INTERPRETATION OF FINDINGS	26
4.1 Data Presentation	26
4.1.1. Demographic Characteristics of the Respondents	26
4.1.2. Results from Secondary Data.....	30

4.2 Results and Discussion	50
CHAPTER FIVE	53
SUMMARY, FINDINGS, CONCLUSION AND RECOMMENDATION	53
5.1. Major Findings.....	53
5.2. Conclusion	55
5.3. Recommendations.....	56
REFERENCES	57
APPENDIX	61

LIST OF TABLES

Table 1: Presentation of the respondents.....	22
Table 2: Distribution of Respondent’s Responses According to Gender.....	26
Table 3: Distribution of Respondent’s Responses According to Age.....	27
Table 4: Distribution of Respondent’s Responses According to the Marital Status	27
Table 5: Distribution of the Respondent’s Responses According to Education Level	28
Table 6: Experience of working in tea factories.....	29
Table 7: Investment and Cost saving before and after Cleaner production in KITABI.....	30
Table 8: Investment and Cost Saving Before and After Cleaner Production in MATA	31
Table 9: Investment and Cost Saving before and after Cleaner Production in NYABIHU	32
Table 10: Return on Assets Before Using Cleaner Production of Three tea factories	33
Table 11: Return on Assets After Using Cleaner Production of Three tea Factories	33
Table 12: Cleaner Production and Environment Conservation	34
Table 13: Cleaner Production and Profitability	49
Table 14: Relationship Between Cleaner Production and Profitability	50

LIST OF FIGURE

Figure 1: Conceptual Framework.....	21
-------------------------------------	----

LIST OF ACRONYMS AND ABBREVIATIONS

CNTL	: National Center for Clean Technology
CP	: Cleaner Production
CTC	: Cutting Tearing and Curling
EMS	: Environment Management System
EUCL	: Energy Corporation Ltd
HACCP	: Hazard Analysis Critical Control Point
ISO	: International organization for standardization
RDB	: Rwanda Development Board
ROA	: Return on Assets
RRECPC	: Rwanda resource efficient and cleaner production center
RRECPCP	: Rwanda Resources Efficiency and Cleaner Production Center
TQM	: Total Quality Management
UN	: United Nation
UNEP	: United Nations Environment Program
UNIDO	: United Nations Industrial Development Organization
USD	: United States Dollars

CHAPTER ONE

INTRODUCTION

1.1. Background to the Study

This chapter covers the background, problem statement, research objectives, research question, significance of the study, limitation and organization of the study.

Most developed and industrialized economies have had some success in decoupling of economic growth and environmental impacts in the past twenty years (Krausmann, 2015). Decades of implementing Cleaner Production (CP) have unquestionably led to improvements in resource usage efficiencies and in reduction at source of pollutants, globally, on a per unit basis of production of products or provision of services.

The mid-1980s witnessed the development and spreading of the CP concepts, approaches and implementation in many locations in diverse industrial sectors. The United Nations Environment Programme (UNEP) defined CP as the continuous application of an integrated, preventive strategy applied to products, production and services that enhances effectiveness while reducing risks to humans and the environment and increasing economic benefits (Berkel, 2000). Since the Rio Earth Summit in 1992, CP has been highlighted as one of the primary measures to use to achieve sustainable industrial development. Under the joint-leadership of UNEP and UNIDO, an increasing number of CP projects have been performed in developing and countries in transition with technical and financial support from developed countries (Geiser, 2000). The first batch of eight NCPCs started in 1994 with funding from European donors and located in Brazil, China, Czech Republic, India, Mexico, Slovak Republic, United Republic of Tanzania and Zimbabwe. NCPCs are spreading gradually worldwide. Now, more than 80 NCPCs or equivalent organizations have played and continue to play prominent roles in promoting and implementing CP at the national, regional and global levels (Luken 2016).

In China, for example, a strategy to implement CP was proposed and endorsed by the Chinese government in 1993. The promotion of CP was listed as one of the top nine priorities on China's Agenda 21, which was also issued in 1993. Implementation of CP has been conducted on different scales of activities and levels of governance and has involved a wide-variety of

stakeholders (Shi and Qian, 2002), and it has documented accomplishments such as the establishment of CP centers at the national and provincial levels; the issuance of the Cleaner Production Promotion Law in 2002, the completion of thousands of CP audit programs at enterprises; 4) the implementation of hundreds of CP projects and the publication and dissemination of Best Management Practices in thirteen major industrial sectors and more than 500 Best Available Technologies.

In the context of global environmental challenges, most developing and countries in transition are increasingly striving to accelerate their transition to green, low or non-fossil-carbon development and circular economy models that are in harmony with ecosystem boundaries and supportive of human wellbeing (Schandl 2016). Essential to this transition is systematic emphasis upon implementation of CP and more sustainable consumption that addresses social, ecological and economic needs in the short and long-term future. This strategy must be incorporated within governmental plans and programs to guide development and to prevent impacts related to the rapid urbanization that characterizes developing and countries in transition. Greater investments are being made in infrastructure such as high-speed trains, smart electrical grids, renewable energy, improved energy efficiency and quality of human life, but much more is needed. Based on the significant contributions of CP to improve environmental performance, many significant innovations are being implemented and envisioned under the flag of the new industrial transition to equitable, sustainable, livable, post-fossil carbon societies (Schandl 2016).

Under globalization, resources extraction, products production, consumption, end-of-life management are inter-connected, integrated and allocated among different countries and regions. Therefore, guarantees of cleaner products and sustainable services are increasingly essential. In this context, global implementation of CP approaches and concepts, which is built upon life cycle thinking for production and provision of products and services is needed. This has been partially done by responsible supply chain management. But much more needs to be done to implement truly ethically responsible, ecologically sustainable green supply chains for cleaner products and services (Schandl 2016).

In 1994, UNIDO and UNEP together started the Worldwide Program of Cleaner Generation Centers, pointing to advance, facilitate and encourage the exercises of the Cleaner Generation in each nation through building neighborhood capacity to execute the CP and preparing of experts

who seem apply the concepts or indeed be balanced to nearby conditions (UNIDO,2002). A number of 25 centers was set up within the following nations since 1995: Brazil, China, Costa Rica, Czech Republic, El Salvador, Ethiopia, Guatemala, Hungary, Korea, Lebanon, Mexico, Morocco, Mozambique, Nicaragua, Slovak Republic, South Africa, Tanzania, Tunisia, Uganda, Vietnam and Zimbabwe. Refers to Navratil and Luken (2007), it was contributed over U\$ 17 million for preparing centers, with a turnover of U\$ 4 million annually.

This Network has completed a decade of operations in Brazil and CP actualized in more than 300 companies, giving changes in natural execution and financial gains. The manufacturing enterprise displayed more growth, job creation work and poverty diminishment, UN (2001). They play a key part in driving feasible economic growth and job creation (Diabate 2014). They are key asset utilization and they produce income for the society by bringing in remote monetary forms from trading merchandise (Boonthawan, 2012).

Only a small proportion of enterprises in Rwanda grow beyond certain threshold, due mainly to lack of specific management and/or marketing skills, and lack of more and sophisticated medium sized enterprises, UNIDO (2007). The industrial growth and competitiveness is constrained by low productivity, low industry base dominated by micro and small enterprises, high transport costs, high cost of financing, high energy costs, limited industrial research and development capacities and low purchasing power *UN (2003)* governance gaps, shortage of industrial skills and many of which are compounded by small, fragmented, and underdeveloped markets EAC (2013) and low integration and clustering between large and small firms (UNIDO 2007).

In this context of such competitiveness constraints, cleaner production (CP) has been adopted in Rwanda as one of environmental and resource utilization strategies needed to overcome such constrains. CP is an opportunity producing procedure, looking for advancements in respects to persistent application of an integrated preventative environmental technique to forms, items and administrations to extend effectiveness and diminish dangers to people and the environment. The CP implementation objectives focuses on environmental protection through good housekeeping, input substitution, technology & Product modifications and reuse and recycling of materials, energy and water. The CP implementation objectives are supplemented by eco-efficiency objectives (Rene 2006).

Eco-efficiency refers to the conveyance of competitively estimated products and services that fulfill human needs and bring quality of life, whereas continuously decreasing environmental impacts and asset escalated all through the life-cycle, to a level at least in line with the Earth's estimated carrying capacity. It focuses on the strategic side of business (value creation) and Cleaner Production on the operational side of business (production). The eco-efficiency objectives are: Decrease the material concentrated of goods and services, reduce the energy escalated of goods and service; decrease the scattering of harmful substances, upgrade recyclability of materials, maximize sustainable use of renewable resources, Amplify item solidness and Increment the benefit concentrated of goods and services (Rene 2006). The underlying competitiveness and profitability challenges of Rwanda's tea factories requires further investigation and avail data for the enterprises thus, the research problem.

Kitabi Tea Factory: Main activity of the company is the production of CTC black tea which is grown in the underlying areas in its own plantation (Industrial block) and villager's plantation (Cooperative and Smallholder parcel). The plantations of Kitabi started in 1969 under a development program financed by the European Union. In addition to the tea the Factory also has forest consisting of 550 ha with the Eucalyptus Trees. The factory was constructed in 1977 and has a capacity to produce 2,400 Tons of Black tea and expected to increase to 4800 tons by 2019. Under the Privatization program of the tea sector, Rwanda Mountain Tea bought 90% of shares, and the cooperative (KOBACYAMU) getting 10%.

Mata Tea Factory: Mata tea factory was constructed in 1981 and is situated in the southern province, 17 km from Huye - Rusizi road. Tea Plantations cover a total area of 1047 ha (1047ha planted). The current production capacity of the factory is 53 tons of Green leaf which gives 15tones of black made tea. MATA Tea Company hires 2000 personnel. Mata tea company ltd is rainforest alliance certified for global sustainable agriculture network and ISO: 9001: Quality management system.

In terms of the process description, green fresh leaf is received from industrial block and one cooperative of farmers and it's quality is analyzed on the reception, when it is 65% of good leaf, it is transported in withering troughs where it is spread on troughs and takes 16 to 18 hours being withered by air and steam, then it is crushed by CTCs (cutting Tearing and Curling) machines, fermented for 90 minutes, dried for 20minutes at temperature between 1400°C and 1000°C, sorted, graded in different grades, packed and stored. This process requires steam for withering

and drying and electricity for motors in all sections. The steam is generated by boiler that consumes firewood and electricity is supplied by EUCL or Generators in case of power cut. It exports products to England.

Nyabihu Tea Manufacturing Plant: Nyabihu Tea Estate is part of the Rubaya - Nyabihu Tea Company, in which Rwanda Mountain Tea Ltd procured majority share offers in 2006 through the privatization program whose point was to surrender offers to private speculators and tea cooperatives to extend the tea division productivity. Nyabihu tea estate has 1,411.97 hectare of land, of which 1,043.54 hectares are covered by tea ranches and staff houses; and 368.43 hectares by fire wood woodland.

1.2. Statement of the Problem

Most of less developed countries' economy and particularly Rwanda, an increase in industrial activities such as demand for electricity and transportation results in poor air quality and emissions have become major issue of concern (Stringer 2010). Raw material prices and higher energy and are making cleaner production to grow in importance and relevance. Cleaner Production (CP) focuses on improved productivity and decreased impacts as the result of plan over the life of products, forms and services (Lakhani 2007). The sum of squander to landfill is expanding consistently. Cleaner Production has picked up world approval for its demonstrated capacity to decrease industry's natural burden whereas at the same time making strides industry's foot line UNEP, (2008). The empirical literature has demonstrated that several scholars have appreciated use of cleaner production towards environmental management and firm profitability (Merycline 2013). The tea factories in Rwanda uses a lot of wood, water and energy during production process which is expensive and less environmental friendly. As a result, CP strategies have been adopted for cleaner production and eco-efficiency objectives. The researcher observed that has pushed him to find out this study, because there is no specific research done in Rwanda by scholars that attempted to evaluate the direct impact of cleaner production and profitability of tea factories in Rwanda. Hence, this is the research gap that the researcher wished to find out during thing the current study with using the following objectives:

1.3. Research Objectives

1.3.1. Main Objective

The main objective of this study is to evaluate the contribution of cleaner production on profitability of selected tea factories in Rwanda.

1.3.2. Specific Objectives

To establish the relationship between cleaner production and profitability of tea factories in Rwanda by assessing if the following eco-efficiency objectives:

1. Examine the joint effect of cleaner production variables on reduced materials use intensity in selected tea factories in Rwanda
2. Evaluate the joint effect of cleaner production on reduced water, energy in selected tea factories in Rwanda
3. Investigate the joint effect of cleaner production on reduced environment impact in selected tea factories in Rwanda.

1.4. Research Questions

1. What is the cleaner production joint effect on reduced materials use intensity in selected tea factories?
2. What is the joint effect of cleaner production on reduced water, energy and wood in selected tea factories in Rwanda
3. What is the joint effect of cleaner production on environment impact in selected tea factories in Rwanda?

1.5. Research Hypothesis

1. H_01 : There is no significant effect of cleaner production on materials use in selected tea factories in Rwanda
2. H_02 : Cleaner production does not effect on water, energy and wood use in selected tea factories in Rwanda
3. H_03 : Cleaner production does not significant on effect environment in selected tea factories in Rwanda

1.6. Justification of the research

The main objective of this research is to find out the relationship between cleaner production and profitability of tea factories in Rwanda. The study had a great importance to policy makers in tea factories and others manufacturing companies in Rwanda. The study generated a body of knowledge to the researchers in areas of cleaner production and competitiveness of manufacturing enterprises. The study helped decision makers for improvement in areas of cleaner production and competitiveness of manufacturing enterprises.

1.7. Scope of the research

1.7.1. Geographic scope

The research was done in three manufacturing industries in Rwanda (MATA, KITABI and MYABIHU). The researcher selected those factories because they were the first factories in tea production which have started using cleaner production am in Rwanda.

1.7.2 Content scope

The research covered the content of cleaner production project and profitability as they are the concepts related with project management scope.

1.7.3 Time scope

It covered an interval of 2015-2018, this interval of time chosen because last factory among those three has adopted the project of cleaner production project since 2015.

1.8. Limitations of the Study

During data collection, some people didn't answered the questionnaire because the security on their job and the security of the institution, since of their availability and the security of the institution. After seeing this problem, the researcher explained to the respondents that the results from them will be only used for academic purpose only.

1.9. Description of the Study

This research work is composed of five chapters which are the following:

Chapter one is the introduction which is covering the introduction, the background of the study, problem statement, objectives, research questions, scope, limitation and description of the study.

Chapter two is the literature review which is composed of the theoretical review, conceptual review, empirical review and conceptual framework.

The chapter three is the research methodology which is composed of research design, target population, data collection instrument, validity and reliability, data analysis and ethical consideration.

The chapter four is the data analysis and presentation which presents the results from interview and questionnaire.

The chapter five is the major findings, conclusion and recommendation.

CHAPTER TWO

REVIEW OF LITERATURE

The second chapter which is literature review dealt with the objectives of this study is reviewed. This section reviewed selected literature that summarized the theoretical review, empirical studies by bringing different literature on the topic to the interrelation between cleaner production and profitability of tea factories.

2.1. Conceptual review

2.1.1. Cleaner production

As a result of intense global industrial development, environmental impacts have evolved on a worldwide basis. The concept of cleaner production refers to actions that allow a company to qualify itself as an efficient user of raw materials and energy during a production process, aiming to increase productivity and consequently, to increase competitiveness and improve organizational performance (Eliana, 2014).

Cleaner technology strategy is a firm's long term planning to avoid negative externality to the natural environment and remain competitive in future markets (Kumar, 2016). Cleaner Production (CP) was known as a preferred economic, environmental and technological strategy, Geraldo, (2018) in achieving an efficient use of natural resources and Pollution prevention. CP can be expanded and applied as an idea for process improvement and can be integrated in any Processes for better environmental performances (Yasup 2015). The concept of cleaner production was introduced by UNEP Industry and Environment in 1989. Cleaner production is the continuous application of an integrated preventive environmental strategy applied to processes, products, and services to increase eco-efficiency and reduce risks for humans and the environment, which aims at making more efficient use of natural resources (raw materials, energy, and water) and reducing the generation of wastes and emissions at the source (Zhongfan, 2008) Analyzing the profitability of any entity, both the volumes of output as well as the costs involved in producing that level of output are taken into account. While direct costs are easily reflected in prices, indirect costs present as external effects to the environment and are not easy to capture through prices (Mercyline, 2013).

Literature shows that the implementation of CP can offer three main impacts on competency, environmental and economic performance for sustainable development. These performance elements were the basis in providing a sustainable manufacturing system where the performance level identified influence by the successful implementation of CP (Yusup 2015). The adoption of clean technology can be described with reference to five types of action: improved operations in the factory; Recycling of waste within the process; Process modification; Replacement of materials and products and Separation of waste materials (Enrico, 2012).

In Rwanda, environmental management and enterprise competitiveness remains a priority. Therefore, cleaner production approaches were adopted and Rwanda resource efficient and cleaner production center (RRECPC, 2017) has been established UNIDO, (2015) and a lot of industries including tea factories have adopted cleaner production strategies for environmental protection and business competitiveness (RRECPC, 2017).

Today, most manufacturing firms have made a significant effort in the implementation of Cleaner production. Nevertheless, different types of efforts on CP will provide different implication (Yusup, 2015). So far, a total of four companies are implementing CP with differing eco-efficiency and competitiveness gains (RRECPC, 2017).

2.1.2. Cleaner Production and Sustainable Development

In the past, companies have often introduced processes without considering the environmental impact. They have argued that a trade-off is required between economic growth and the environment, and that some level of pollution must be accepted if reasonable rates of economic growth are to be achieved. This argument is no longer valid, and the United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro in June 1992, established new goals for the world community that advocate environmentally sustainable development.

Cleaner production can contribute to sustainable development, as endorsed by Agenda 21, Cleaner production can produce or eliminate the need to trade off environment protection against economic growth, occupational safety against productivity, and consumer safety against competition in international markets. Setting goals across a range of sustainability issues leads to “win-win” strategy: it protects the environment, the consumer and the worker while also improving industrial efficiency, profitability and competitiveness. Cleaner production can be especially beneficial to the developing countries and those undergoing economic transition. It

provides industries in these countries with an opportunity to “leapfrog” those more established industries elsewhere that are saddled with costly pollution control.

2.1.3. Cleaner Production Quality and Safety

Food safety and food quality are very important aspects of the food industry. While food safety has always been an important concern for the industry, it has received even greater attention over the past decade due to the larger scales of production, more automated production processes and more stringent consumer expectations. A stronger emphasis is also being placed on quality due to the needs of the companies to be more efficient in an increasingly competitive industry. In relation to the food safety, Hazard Analysis Critical Control Point (HACCP) has become a widely used tool for managing food safety throughout the world. It is an approach based on preventing microbiological, chemical and physical Hazard in food production process by anticipating and preventing problems rather than relying on inspection of the finished products. Similarly, quality system such as Total Quality Management (TQM) are based on a systematic and holistic approach to production process and aim to improve product quality while lowering costs. Cleaner production should operate in partnership with quality and safety systems and should never be allowed to compromise them. As well, quality, safety and cleaner production systems can work synergistically to identify areas for improvement in all three areas (Berkel 2002).

2.1.5. Cleaner Production and Environmental Management System

Environmental issues are complex, numerous and continually evolving, and an ad hoc approach to solving environmental problems is no longer an appropriate. Companies are therefore a more systematic approach to environmental management, sometimes through a formalized environment management system (EMS). An EMSs have evolved, a need has arisen to standardize their application. An evolving series of generic standards has been initiated by the international organization for standardization (ISO), to provide company management with the structure for managing the environmental impact (Salvador 2015).

2.1.6. Understanding Profitability

Profitability is the primary goal of all business ventures. Without profitability the business will not survive in the long run. So measuring current and past profitability and projecting future profitability is very important. Profitability is measured with income and expenses. Income is money generated from the activities of the business. However, money coming into the business from activities like borrowing money does not create income. This is simply a cash transaction between the business and the lender to generate cash for operating the business or buying assets. Expenses are the cost of resources used up or consumed by the activities of the business. For example, seed corn is an expense of a farm business because it is used up in the production process. A resource such as a machine whose useful life is more than one year is used up over a period of years. Repayment of a loan is not an expense; it is merely a cash transfer between the business and the lender. Profitability is measured with an “income statement”. This is essentially a listing of income and expenses during a period of time (usually a year) for the entire business. An Income Statement is traditionally used to measure profitability of the business for the past accounting period. However, a “pro forma income statement” measures projected profitability of the business for the upcoming accounting period, (Callon 1987).

2.1.7. Reasons for Computing Profitability

Whether you are recording profitability for the past period or projecting profitability for the coming period, measuring profitability is the most important measure of the success of the business. A business that is not profitable cannot survive. Conversely, a business that is highly profitable has the ability to reward its owners with a large return on their investment. Increasing profitability is one of the most important tasks of the business managers. Managers constantly look for ways to change the business to improve profitability. These potential changes can be analyzed with a pro forma income statement or a Partial Budget. Partial budgeting allows you to assess the impact on profitability of a small or incremental change in the business before it is implemented. A variety of Profitability Ratios (Decision Tool) can be used to assess the financial health of a business. These ratios, created from the income statement, can be compared with industry benchmarks. Also, Income Statement Trends (Decision Tool) can be tracked over a period of years to identify emerging problems (Delano 2013).

2.1.8 Ways to Measure the Profitability

If the revenue from your products and services is covering your expenses, you're turning a profit. However, a profit dollar amount won't tell you *why* you're profitable. By calculating and comparing a handful of financial metrics, you can identify the areas of your business that are working well and those that need improvement (Delano 2013).

2.1.8.1. Net Profit Margin

Net profit margin referred to as just "profit margin," is the big picture view of your profitability. To calculate the margin, divide net profit total revenue minus all expenses by revenue. What's considered a good margin is relative. Some industries like financial services, pharmaceuticals, medical, and real estate have sky-high profit margins, while others are more conservative. Use industry standards as a benchmark and perform an internal year-over-year comparison to assess your performance (Delano 2013).

2.1.8.2. Gross Profit Margin

To calculate gross profit margin, divide gross profit by sales revenue. If gross profit margin is high, that means that you get to keep a lot of profit relative to the cost of your product. If it's less than 50 percent, that means your product costs comprise more than half of your sales revenue. A low gross profit margin isn't necessarily bad it just means you need to sell enough product to be able to cover your general expenses. However, if you're selling the same products and your gross profit margin is decreasing year-over-year, you need to find a way to reduce direct product costs or raise product prices (Delano 2013).

2.1.8.3. Profit by Segment

A lot of small businesses are subject to the 80/20 rule: Eighty percent of revenue comes from 20 percent of customers. Segment your business by product or service lines to find out which areas of your business have the best revenue and net income. There are two ways to calculate profit by segment. One option is to identify the specific revenue and costs associated with the segment. If you do this, you'll ignore overhead costs like business insurance, rent, utilities, and executive salaries (Delano 2013).

2.2. Theoretical Review

This chapter presents theoretical and empirical literature review, critical review and conceptual framework of the study.

2.2.1 By-product recovery theory

From the environmental point of view, by-product recovery is an efficient method of waste reduction and may also lead to an economic gain. But in the past, only a low percentage of by-products were recovered from waste. This approach obviously reduces the waste disposal or pollution problem. There are many examples available with positive results from industries:

Metal-plating industries recover metals like copper, nickel and chromium from plating solutions by using ion exchangers, the recovery of sulphite waste-liquor as a by-product from pulp and paper mills leads to a significant pollution reduction. This by-product is used in the production of road binders, cattle fodder and insulating compounds, slaughterhouses recover waste blood for the manufacture of glue (Nemerow, 1978).

2.2.2 Process chemicals and raw materials recycling theory

From the point of view of sound management of non-renewable resources, recycling has always made sense. The major advantage of recycling and recovery is that it reduces the need for raw materials and, thereby, leads to a significant resource-saving. The significant reduction that results from recycling of used materials not only provides a cheaper product, but also benefits the environment through smaller energy demands and reduced pollution loads.

2.2.3 Changing of production processes to reduce waste

Changing the production process is an important technique for reducing waste volume and strength. Waste treatment from the source itself should be considered as an integral part of production. It is possible to reduce the volume of waste by:

Improving process control, improving equipment design, using different or better quality of raw materials, good house-keeping, adopting preventive maintenance and modifying equipment (Taylor 1964).

Changes in equipment can lead to reductions in the toxicity of wastes. Slight changes are often made in the existing equipment set-up to reduce the waste such as putting traps at the discharge pipeline in poultry plants to prevent emission of feathers and pieces of fat (Taylor 1964).

2.2.4 Waste management theory

Classifying and segregating wastewater can considerably reduce the volume that requires intensive treatment. It may be classified as process wastewater, cooling water, wash water, etc. In some plants, the process water may be further classified into different types, depending on the pollution load of each wastewater. In many plants, it is possible to recycle the cooling/process water several times and treat it at the end of its usefulness.

This reduces the strength and /or the difficulty of treating final waste. It is easier and more economical to treat a small volume of concentrated waste than a large volume of diluted waste. Another type of segregation is the removal of one particular process waste from the other process wastes of an industrial plant which renders the major part of the waste more amenable for treatment.

Accidental discharge of significant process solutions represents one of the most severe pollution hazards. Preventive measures should be considered:

Make sure that pipelines and valves in the plant are clearly defined, allow only designated and knowledgeable persons to operate these valves, install indicators and warning systems for leaks and spills, provide a detection facility for spilled wastewater by having holding basins or lagoons (until proper waste treatment can be accomplished), establish a regular maintenance program of all pollution abatement equipment and production equipment which may result in a liquid discharge to the sewer, install a proper storage facility for raw materials, products and by-products and recycle accidental spillages, if any, within the process (Nemerow, 1978).

2.2.5 Raw and process material change theory

In some industries, change of raw and process materials results in less or no pollution being generated.

For example, the substitution of chlorine, which is used for bleaching pulp in the paper industry by hydrogen peroxide or ozone, will reduce the pollution load by eliminating toxic chlorinated organic compounds.

2.2.6 Fresh water management theory

Better and economic use of water within industries can be achieved through the following ways:

Regrouping industries in a particular place when combined (fastening and electroplating industries reduce the waste quantity), rationing water use within the industry (each person uses defined quantity of water), re-organizing water use in different processes, efficient washing processes (such as counter-current washing, high pressure air rinsing, cascade circuits, etc.) and re-use of bath water (i.e. plating bath in metal plating industry).

2.3. Empirical Review

In literature, the relationship between cleaner production and profitability of firms has been appreciated (Mercyline, 2013) Cleaner technology strategy is a firm's long term planning to avoid negative externality to the natural environment and remain competitive in future markets (Kumar, 2016). Through the proactive action, manufacturing firms could create additional business opportunities to establish the new way to manufacture the product for the sustainable development (Yusup, 2015).

Cleaner production is attractive in that, together with reducing the cost of production, there are benefits that accrue from the reduction of environmental contaminants that result from unclean production processes practices by firms may have an impact on a firm's profit through increased operational costs while sound environmental practices may be a source of financial gain for the firm (Mercyline, 2013).

Evidence further shows that environmentally conscious companies have better financial performance than those companies that are categorized as not environmentally conscious (Ahmed, 1998)

Firms must develop sustainable technologies and products that do not exist yet to reduce the burden on natural resources and build sustainable competencies (Hamel, 1991). Breakthrough product and process innovation is required to optimize the use of scarce and non-renewable natural resources in products (Bringezu, 2009) and eliminate wastes and emissions within and outside the organization boundary to take efficiencies to unprecedented level (Seuring, 2008).

Sustainable firms are generally strategically proactive and undertake development of disruptive products and processes and create new markets (Aragon-Correa 1998).

Implementation of CP has successfully providing the promising effects to the manufacturing firms. The appropriate implementation of CP will influences the economic, environmental and manufacturing competency and provide a basis practice of the circular economy(Hicks 2007).

It can provide a numerous beneficial impact such as increase recyclability, using less energy consumption, reduce the pollution emission of substances, produce less amount of waste, nominal use of natural resources, nominal use of packaging material, decrease raw material usage, better safety practice, avoid penalties due to violation of environmental law, proactive in preventing pollution and bring blaze intention force for the innovation (Yusup 2015).

The Cleaner production strategies can act directly on the cost efficiency factors, influencing internal company performance through increased productivity, better use of resources, improved process efficiency and, obviously, reduced environmental impact a direct link between the reductions in waste generated within a production site and increased company cost efficiency (Enrico 2005).

Cleaner Production (CP) was known as a preferred strategy in achieving an efficient use of natural resources and Pollution prevention. From the perspective of thinking, CP can be well-defined as the use of key concepts in the overall prevention, eco-efficiency & environmental strategies. Proper CP practices by manufacturing firms will produce the economic and environmental benefits, and basis for the realization of circular economy (Enrico 2005).

Today, most manufacturing firms have made a significant effort in the implementation of CP (RRECPC, 2017). Nevertheless, different types of efforts on CP will provide different implication. Result from the implementation of CP can serve as the basis for improving the performance or efficiency (Zeng, 2010).The increasingly cost of environmental, operations, market, regulatory, voluntary initiatives and international standards was an important measures for the implementation of CP. However, some manufacturing firms are still reluctant to take more aggressive and proactive actions towards CP due to perceived lack of evidence that the implementation of CP exceed the costs required in implementing this strategy (Montabon, 2007).

2.4. Gap in Literature

From the literature, it was evident that most of the studies were done in the developed world with very little having been carried out in Africa and particularly in Rwanda. Further, the studies that have been done locally have focused on the big industries without narrowing down to small factories.

According to The United Nations Environment Programme, CP is defined as the continuous application of an integrated preventative environmental strategy to processes, products, and services to increase efficiency and reduce risks to humans and the environment (UNIDO 2015).

This concept emerged in response to the need to disseminate information on sustainable development to enterprises, government agencies, and the academic community so that the impact of industrial activities on ecosystems could be understood and minimized. This understanding aids the identification and resolution of the problem of wasted raw materials in manufacturing processes. CP must be included in manufacturing processes in order to reduce emissions and to promote the use of resources in an eco-efficient manner (Glavic 2007).

CP was initially introduced in Brazil in 1995 through the creation of the National Center for Clean Technologies (CNTL). The Brazilian Network subsequently supported the Center in order for CP work centers to be installed in all Brazilian states (Pereira 2012).

CP analyzes aspects related to the operation of a business and identifies opportunities for improvement, in terms of both economic and environmental performance (Khan 2008).

Works that use bibliometric, meta-analyses, content analyses, and systematic reviews related to CP stakeholders include methanol production, sustainable development, similarities and differences in the concept of CP, carbon dioxide reuse in the production of leather, and barriers and CP strategies. Staniskis (2012) conducted analysis in different cases of researches carried out in Austria, Bulgaria, Estonia, Lithuania and Spain, denoting that the best results can be achieved when all stakeholders work together to implement sustainable production and consumption. However, seeking stakeholder's cooperation in environmental and economic practices is a challenge.

Riaz, (2013) reviewed how CP is used in the methanol production process. The main purpose was to highlight the problems associated with the production of methanol, as well as to comply

with the efforts of scientists and researchers to overcome these problems using modeling and optimization. Furthermore, they discussed the environmental benefits of methanol in reducing carbon dioxide (CO₂). Their findings indicate that methanol can increase consumption when mixed with fuel gas. Fluidized bed reactors, membrane reactors, and thermally coupled reactors are more viable, and have the potential to contribute to CP.

Karatzoglou, (2013) compiled a literature review of education for sustainable development from articles published between 2003 and 2011. The results showed that CP is an excellent strategy for sustainable development. The most relevant journals were the Journal of Sustainability in Higher Education and the Journal of Cleaner Production, which included case studies.

Sengwan, (2015) reviewed green manufacturing and similar structures in order to trace the origin, definitions, scope, similarities, and differences of green manufacturing; environmentally conscious manufacturing; environmentally responsible manufacturing; environmentally benign manufacturing; sustainable manufacturing; clean manufacturing; cleaner production; and sustainable production with reference to the triple bottom line, product life cycle engineering, the systems approach, resource and energy efficiency, supply chains, and pollution prevention. Their results showed the need for standardization, because the aforementioned terms are not used consistently as concepts. In general, these terms focus on the life cycle, formulating end-of-life strategies, including the overall supply chain, and integrating environmental improvement strategies with business strategies.

Chen, (2015) reviewed carbon dioxide delimiting in leather production, and proposed reusing carbon dioxide by means of available absorption and desorption technologies, which reduces occupational safety risks, regenerates new resources, and leads to CP. Moreover, they give an overview of the fundamentals, process optimization, occupational safety, and possible ways forward for carbon dioxide delimiting in leather, and provide useful information to researchers and engineers in this field.

Deng (2016) conducted a literature review on the application of supercritical carbon dioxide in leather processing, and found opportunities to use carbon dioxide as a potential alternative solution for the CP of leather.

Vieira, (2016) conducted a survey to identify why CP is not widely adopted based on a systematic review of 37 articles distributed between 1994 and 2014. Their findings showed that regulations need to be more than simply a legal requirement, and must be seen as an opportunity for improvement. In addition, they identified characteristics that must be emphasized in methodologies and tools that can help in the execution of CP programs. These characteristics are related to culture, policies, methodologies adopted, education, and a lack of social pressure. It is necessary to promote the dissemination of knowledge and commitment within the entire chain of businesses, academics, governments, and the community.

Chang, (2015) used a spatial and temporal analysis to show the geographical characteristics, regional differences, time variations, and industry allocations of CP development in China. In addition, they emphasized the implementation of CP in various industries to further demonstrate the regional characteristics of CP development in China. Finally, they proposed suggestions to promote the use of CP management systems for future CP development in China. The above findings indicate many deficiencies and gaps. With regard to the gaps, possible actions and measures include the following. First, to perfect the institutional system, it is necessary to institute supporting and supplemental regulations and policies in order to enhance the pertinence, compulsion, and enforceability of laws and provisions and to increase the applicability of CP to industries. In addition, it is highly recommended that CP be integrated with environmental management. Second, to improve administrative management, it is necessary to refine the scope of work for government agencies and to establish collaborative procedures and coordinating mechanisms between government departments, such as the environmental protection bureau, the competent authority of the industrial sector, and funding management agencies. Third, to expand China's funding sources, it is necessary to institute policies that encourage the use of CP, including emission reduction incentives, CP subsidies, tax exemptions and reductions, and bank financing. Fourth, it is necessary to improve the technical capacity, including regular training sessions, annual performance evaluations, and the development of a professional qualification certificate system. Therefore, although CP development in China is generally increasing, there

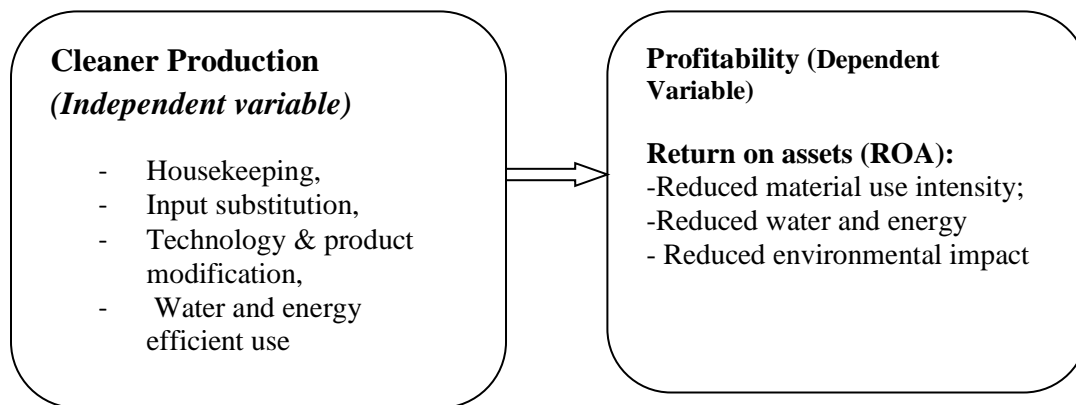
are clear geographically significant differences across regions, with considerable disparity in industrial allocation, especially for key enterprises, owing to government initiatives. Thus, it would be beneficial to CP development in China if regionalized CP management systems were established and operated based on key geographical features, regional differences, and allocations among the various industries.

2.4. Conceptual Framework

The conceptual framework focuses on the relationship between cleaner production and profitability by measuring eco-efficiency objectives for tea factories in Rwanda.

The analysis of the empirical relationship between eco-efficiency and profitability of firms involves an estimation procedure based on a panel data model, in which eco-efficiency is assumed to influence the profitability variable, which is the dependent variable. The profitability shall be measured by determining economic and environmental impact or gains calculated based on Return on assets (Yusup, 2015). The basic conceptual model is specified as follows:

Figure 1: Conceptual Framework



Source: Researcher (2019).

The researcher postulates there might be other moderating variables related to the factories' quality of equipment, infrastructure, leadership and management commitment and capabilities of cleaner production methods teams that may affect the relationship between independent and dependent variables. In testing the relationship between the two variables, the researcher will hold the moderating factors constant.

CHAPTER THREE

METHODOLOGY

3.1. Research Design

According to Creswell (2014) a research design is the set of methods and procedures used in collecting and analyzing measures of the variables specified in the problem research. The design of a study defines the study type and sub-type, research problem, hypotheses, independent and dependent variables, experimental design, and, if applicable, data collection methods and a statistical analysis plan. A research design is a framework that has been created to find answers to research questions.

The research used quantitative and qualitative approach for data collection methods in this project to find out the relationship relied on cleaner production and profitability. Secondary data collected through the reports including technical and finance provided by selected factories. The Interview guide used to collect qualitative data for further analysis. In this process, the researcher contacted cleaner production project technicians within specific factories. This intended to have the approaches complimenting each other in eliciting the truth.

3.2. Population of the study

According to Grinnell (1990) identified population of the study as the totality of the people which the research is concerning with. The research population is composed by formal medium and large tea manufacturing factories that are registered in Rwanda development board (RDB). Specifically, the study assessed only three tea factories that implements cleaner production project in their function process in Rwanda.

3.2.1. Sample Design

Purposive sampling (also known as judgment, selective or subjective sampling) could be a testing strategy in which a researcher depends on his or her claim judgment when choosing respondents among big size to take part within consideration of the study (Thornhill 2012). Hence, a sample size was composed of 10 staff implementers of cleaner production project in

each factory among those three manufacturing plants, implies that the whole sample size are 30 respondents.

Table 1: Presentation of the respondents

Factory name	Respondents	Department
Kitabi tea factory staff	10	Production
Mata tea factory staff	10	Production
Nyabihu tea factory staff	10	Production
TOTAL	30	

Source: Researcher, (2019)

3.3. Data Collection Instruments

During the carrying out this research, the questionnaire was used. It was classified in three sections: the first sections was the demographic characteristic of the respondents, the second section concerned with the impact of secondary data reports on investment and saving of each tea factory and the third part focused on respondent’s views about cleaner production and profitability. Close-ended questions utilized to unlawful speedy reactions from respondents. This sort of questions permitted for adaptability and allows respondents to give answers to the question. Descriptive statistical techniques displayed within tabulation summarized the results from the respondents.

3.3.1. Interview

Agreeing to Campion (1994) interview is a discussion among two persons where the objective of the question is to understand the respondents’ views about the study. A personal interview was coordinates into the study since they made a difference to urge the story behind the extend implementers’ habit. This method was supportive in seeking after in-depth data around the subject.

3.3.2. Questionnaires

A well-constructed and organized questionnaire can be an effective instrument to illuminate the quality of inquires about assessment (Cooper 2006). And in the event that ineffectively outlined, the questionnaire can make research troublesome and deceiving for both those the researcher and the analysis of information. Questionnaire for the most part comprises of a constrained number of questions that inquire members their recognition or rate the adequacy of different viewpoints of activities (Cooper 2006).

3.4. Administration of Data Collection Instruments

The researcher utilized the technique of dropping the questionnaire to who was chosen among project implementers of cleaner production project to reply the questions and pick it after replying. It gave the researcher to gather more data in little time. The secondary information was utilized too including yearly report, publication, websites, diaries, etc.

3.5. Reliability and Validity

The data collected from respondents was gotten by the way of an approval procedure of the body of which the questionnaires distributed. The strategy was concurred upon from the respondents chosen to provide the desired information. The researcher makes beyond any doubt that the given data had substantial source of reference where the data was found in case it was appeared fundamental; subsequently it was contributed to the confirmation that the data given validated and valued.

The researcher gave the questionnaires to the concerned respondents who chosen from the entire population. The data which was collected, supposed to be measured to guarantee its size by using frequency and percentages, in order to prove the instrument reliability with the study goals. In addition the questionnaires signed by the respondents to guarantee its consistency and accountability for future safety.

3.6. Data Analysis Procedures

Wanyama (1982) indicates that during data analysis process, the researcher made a bunch of data and processed in an assortment of ways in order to appear what they were important and to help the readable of the results. The data gotten in questionnaire analyzed utilizing (SPSS) and after displayed in the tables. Particularly, the analysis was conducted by utilizing the frequency and percentage.

3.7. Statistical tools

For completely analyze the data for this project, here are the necessary tools of statistic that were used.

- ❖ Multiple regression analysis
- ❖ Correlation analysis
- ❖ Chi-square test

3.8 Ethical Consideration

Malhotra (2006) reported that ethical consideration incorporate informed consent, voluntary participation, doing no harm to the respondents, secrecy, privacy, selecting the respondents fairly. The researcher clarified the reason of the study and after that asked for formal authorization. After getting the clearance from authorities of the project, the researcher has gotten the consent from the respondents by the use of the basic letter on the questionnaire. This letter was accommodating a guarantee to the respondents that the data collected from them and they used only for academic purposes. Assist, the respondents guaranteed the privacy of any data they responded since they asked not to demonstrate their names.

CHAPTER FOUR

DATA ANALYSIS AND INTERPRETATION OF FINDINGS

4.1 Data Presentation

This chapter presents data collected from the field and their presentation. These data obtained from questionnaire and interview with the sampled tea factories staff.

4.1.1. Demographic Characteristics of the Respondents

The purpose of showing identity of respondents is to clarify the age in case of showing that the results corrected from different group of age; marital status, gender to bring gender equity in the results, etc.

Table 2: Distribution of Respondent's Responses According to Gender

	Frequency	Percent (%)
Female	10	33.3
Male	20	66.4
Total	30	100

Sources: Primary data March, 2019

From the table 2, it can easily observe that the big group takes the highest percentage of 66.4% are male and 25% are female this showing that the most staff in those tea companies were male. This means that the gender balance in tea factories was somehow employed as it is 1/3 of the total population. As conclusion here, you can say that female are also somehow encouraged to join the tea factories as it is has shown by different of male and female. This is a significant number comparing to the previous years in Rwanda about gender equity in private and Government sectors.

Table 3: Distribution of Respondent's Responses According to Age

	Frequency	Percent (%)
20-30	6	20
31-40	8	26.6
41-50	11	36.7
51 and above	5	16.7
Total	30	100

Source: Primary data March, 2019.

From the table 3, the highest number of respondents was between the ranges of 41-50 years which were 36.7% this is because the most of people from 41-50 years were mature enough to understand well the advantages of advantages of cleaner production effects on the tea factories. This means that peoples who are less than 50 years are mature and they are in productive age, where their mindset are changed and the people who are above 50 years were in administrative level where the plans and others execute. The following range is 31-40 years which has the percentage of 26.6% this group also are mature to operate in production department, they have fitness and freshness. The next group of age is the range of 20-30 years who were more to spend their efforts in execution of the project while people above 51 years old were directors of the tea factories with representation of 16.7%. It means that in tea factories there are all categories of age group in different levels of operational of the factories.

Table 4: Distribution of Respondent's Responses According to the Marital Status

	Frequency	Percent (%)
Married	20	66.7
Single	9	30
Widow	1	3.3
Total	30	100

Source: Primary data March, 2019

From the table 4, respondents classified on the basis of their marital status. Where the most respondents are married with the highest percentages of 66.7%, they followed by single with 30% and widow with only 3.3%. This is because most of couple or married are the one who attributed the highest responsibilities in factories and in any other institutions because of they have a permanent address and they are capable to handles their tasks with commitments greater than any others.

Table 5: Distribution of the Respondent’s Responses According to Education Level

	Frequency	Percent (%)
PhD	0	0
Master	5	16.6
Bachelor	20	66.6
Secondary	3	10
Primary	1	3.3
None education	1	3.3
Total	30	100

Source Primary data March, 2019

From table 5 showed that 66.6% of respondents had Bachelor’s degree, this level of degree allowed them to have much knowledge in terms of technical skill to implement the cleaner production system in tea factories, the following education level is 16.6% of the total respondents who have finished Master’s Degree, the have also an advanced skills in cleaned production, 10% had Secondary level education, 3.3% respondents have primary level and 3.3% didn’t have academic background. This shows that above 97% of the total respondents had some knowledge about cleaner production in tea factories.

Table 6: Experience of working in tea factories

	Frequency	Percent (%)
1-3 Years	4	13.3
4-6 Years	5	16.7
7-10 Years	10	33.3
11 Years and above	11	36.7
Total	30	100

Source: Primary data March, 2019.

According to the table 6, the results showed that the majority of the respondents 36.7% had above 11 years of experience in tea factories, this means that they mastered well the functions of the tea factories and the challenges also the factory encountered. The second group was represented by 33.3% who were between 7-10 years, it means that they had also a lot of experience in choosing profitable projects within the factory which will contribute to the highest profit and saving cost of materials consumed by the factory. 16.7% of the respondents they had an experience between 4-6 years, it was also a significance experience where they have participated in project activities, and the last group of age of experience was 1-3 years with 13.3% of respondents. In general, all the respondents in this research are more experienced in the tea factory where in implementation of cleaner production in those factories was initiated by the experienced in tea factories' activities. The more they are experiences in tea factories the more they know the profitable projects that the factories have to implemented.

4.1.2. Results from Secondary Data

These results obtained from the reports of the tea factories through their reports and publications.

Table 7: Investment and Cost saving before and after Cleaner production in KITABI

	Before CP		After CP	
	Invest	Cost saving	Invest	Cost saving
Energy	14,899 \$	45,253 \$	10,365 \$	55,820 \$
Water	10,215 \$	25,000 \$	9,950 \$	31,000 \$
Wood	9,856 \$	17,890 \$	5,200 \$	21,000 \$
Technology	15,045 \$	11,000 \$	10,670 \$	18,000 \$
Total	50,015 \$	99,143 \$	36,180 \$	109,620 \$

Researcher, Kitabi tea Factory report, 2019

In the table 7 Kitabi Tea Company invested in improving its power factor to avoid the penalties in electricity bills payment and the company has been able to change power factor from 0.78 in 2015 to 0.91 in 2018. The savings recorded were almost 55,820 \$ after cleaner production project. It has also invested in replacing the 400 fluorescent tube lights of 40watts to LED (Light Emitted Diode) of 16watts. Annual Resource Efficient and Cleaner Production (RECP) benefits were US \$ 45,259 saved through energy efficiency against USD 14,899 before cleaner production, while after the cleaner production period the factory invested less amount 10,365 \$ and get more saving of 55,820 \$.

In summary the annual Resource Efficient and Cleaner Production (RECP) total investment before were 50,015 \$ and the saving was 99,143 \$ and when comparing with the situation after the cleaner production project the total investment was reduced to 36,180 \$ while the total saving highly increased to 109,620 \$. The awareness, capacity building and sharing the best practices have assisted the Kitabi Tea factory RECP team members and the employees in general to be more vigilant in terms of resources use and efficiency. The factory was really happy with benefits gained through RECP implementation and those benefits are summarized in improving environmental situation, increasing economic benefits, increasing productivity, gaining

competitive advantage and these achievements contributed a lot to obtain the company's award: ISO 22000:2005 (Food Safety Management System) and Rainforest Alliance certification for environmental, social and economic sustainability.

Table 8: Investment and Cost Saving Before and After Cleaner Production in MATA

	Before CP		After CP	
	Invest	Cost saving	Invest	Cost saving
Energy	70,100 \$	17,910 \$	50,000 \$	99,820 \$
Water	15,789 \$	27,569 \$	11,950 \$	24,250 \$
Wood	12,930 \$	15,111 \$	8,222 \$	15,032 \$
Technology	17,888 \$	14,000 \$	12,500 \$	13,625 \$
Total	116,707 \$	74,590 \$	82,672 \$	152,727 \$

Researcher, Mata tea Factory report, 2019

In the table 8 showed that an implementation of RECP in Mata tea company had different economic benefits of USD 74,590 \$, energy is costly but actually, the cost is lowering day after day, product maximization is giving a lot benefit, RECP has helped the company to comply with the certification called Rainforest alliance and this extend the market and give the value to products of the company.

The company was losing its soil and its tea plants due to erosion and actually the production is growing as the company implemented RECP mitigation measure of using sand bags to strengthen river banks. Many trainings are provided to workers which are giving the required knowledge to them and the company is yielding from them. MATA tea factory has reduced in firewood from 3.8 to 3.2 stere/ton of making tea (0.6 stere reduction per ton) for an average of 2,000 tons per year, saving were 1,200 stere per year and two acres saved per year. About water it has reduced the consumption of water form 600m³ per year, 1,500m³ of treated wastewater reused in farming. It has also reduced the energy consumption for lighting by de-lamping non-working light.

Table 9: Investment and Cost Saving before and after Cleaner Production in NYABIHU

	Before CP		After CP	
	Invest	Cost saving	Invest	Cost saving
Energy	266,155 \$	170,350 \$	215,365 \$	270,453 \$
Water	136,310 \$	92,540 \$	85,520 \$	99,548 \$
Wood	176,379 \$	100,000 \$	125,589 \$	155,326 \$
Technology	336,863 \$	115,943 \$	286,073 \$	315,000 \$
Total	915,707 \$	478,833 \$	712,547 \$	840,327 \$

Researcher, Nyabihu tea Factory report, 2019

In the table 9 Nyabihu tea factory has invested more money comparing to other three tea factories where in energy efficient lights the factory has Installed energy-efficient lights and switch them off when they are not required, It has also installed skylights and used natural lighting where possible. Before the introduction of cleaner production, the factory in energy has invested 266,155 \$ and saved 170,350 \$ while after using cleaner production system the factory has invested less than before 215,365 \$ and saved 270,453 \$ which means that during the cleaner production the NYABIHU Tea Factory has gained more comparing to the previous years. In water, the company has invested 136,310 \$ and saved 92,540 \$ before the adoption of cleaner production, where after cleaner production the factory has invested 85,520 \$ and saved 99,548 \$. It means that the factory water investment has gained because after the using of cleaner production, it has invested less money and saved more money comparing to the previous years. Briefly as it was presented in the table, the increase of saving more money were appeared also in wood and technology, which means that in general the introduction of cleaner production in NYABIHU Tea Factory has contributed more to the profitability of the factory.

Table 10: Return on Assets Before Using Cleaner Production of Three tea factories in three years (2013-2015)

	Net Income (frw)	Total Asset (frw)	ROA
Kitabi Tea Factory	1,700,000,000	20,400,000,000	8.3%
Mata Tea Factory	996,000,000	14,100,000,000	7.7%
Nyabihu Tea Factory	1,500,000,000	12,000,000,000	12.5%

Source: Secondary data, 2015

The table 10 showed the ROA before the implementation of Cleaner project in those three tea factories in three years before implementing the cleaner production, where in Kitabi tea factory each dollar invested in asset have generated 8.3% of net income, in Mata tea factory each dollar invested have generated 7.7% of net income and in Nyabihu Tea Factory each dollar invested have generated 12.5%. It means that during those three years the factories

Table 11: Return on Assets After Using Cleaner Production of Three tea Factories in three years (2016-2018)

	Net Income (frw)	Total Asset (frw)	ROA
Kitabi Tea Factory	2,850,000,000	17,220,000,000	16%
Mata Tea Factory	1,196,000,000	9,100,000,000	13.1%
Nyabihu Tea Factory	1,900,000,000	11,000,000,000	17.2%

Source: Secondary data, 2018

In the table 11 showed the comparison of two tables 4.9 and 4.10. Due to the investment in the cleaner production on an interval of three years before and after cleaner production, it showed that the three tea factories have taken a hit in the level of profits they generate using investments in the available assets. Where every dollar that Kitabi tea factory's has invested in assets after implementation of cleaner project, it has generates 16% of net income which was a round of a double before the implementation of that project where each dollar invested has generated 6.3% on net income. About Mata tea factory, each dollar that invest in after cleaner production project was generating 13.1% of net income while before the project each dollar invested has generating 7.7% and finally in Nyabihu tea factory on each dollar invested after cleaner production implementation project it was generated 17.2% while before the project each dollar invested has generated 12.5% the results showed that all three tea factories benefited after implementing the cleaner production project. Nyabihu tea factory was better at converting its investment into profits, compared with Mata and Kitabi.

Multiple regression analysis

This analysis is used only when it is desired to assert the partial effect of each independent variable. The term partial effect that is used here is kept in mind as the effect of the given independent variable on the dependent variables.

The independent variable selected for the analysis could be quantitative variable or qualitative variable.

Here the multiple Regression has taken the following term.

The model is

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + e$$

Where, e is the disturbance term.

The first basic assumption of the model is that the vector of sample observations on Y may be expressed on linear combination of the sample observations on the explanatory variables plus the disturbance vector.

$$Y = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \dots + \beta_p X_{pi} + e_i \quad (i = 1, 2, \dots, n)$$

Where β_0 denotes the intercept, $\beta_1, \beta_2, \dots, \beta_p$ are partial regression co-efficient and residual term associated with its observation.

$Y = n \times 1$ column vector of observation of dependent variable.

$X = p \times 1$ matrix result from observation of independent variables X_1, X_2, \dots, X_p

$b = p \times 1$ column vector of unknown parameter $\beta_1, \beta_2, \dots, \beta_p$

$e = n \times 1$ column vector of residual e_i

The parameter of the model was estimated using OLS technique. The sufficiency of the model is tested by using the conventional F-test and using the value of R^2 .

The model used is

$$Y = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + e_i$$

$X_{1i}, X_{2i}, X_{3i}, X_{4i}$ are independent variables.

Where, $Y =$ difference of cost

$X_1 =$ quantity produced in a batch before CP

$X_2 =$ quantity produced in a batch after CP

$X_3 =$ Time consuming in a batch before CP

$X_4 =$ Time consuming in a batch after CP

To test whether the difference of cost between the materials used before and after cleaner production and various collected variables influence the difference of cost.

The details of the results are given below

Variables Entered/Removed^b

Model	Variables Entered	Variables Removed	Method
1	Quantity produced in a batch before CP, quantity produced in a batch after CP, Time consuming in a batch before CP, Time consuming in a batch after CP		Enter

- a. All requested variables entered
- b. Dependent variable: difference of cost

Model summary

Model	R	R square	Adjusted R square	Std. Error of the Estimate
1	.895 ^a	.78660	.78660	79385.386

- a. Predictors: (Constant), Quantity produced in a batch before CP, quantity produced in a batch after CP, Time consuming in a batch before CP, Time consuming in a batch after CP.

ANOVA^b

Model	Sum of squares	Df	Mean square	F	Sig.
1 Regression	1.941E14	4	4.853E13	4912.776	.000a
Residual	1.926E12	195	9.877E9		
Total	1.960E14	199			

- a. Predictors: (Constant), Quantity produced in a batch before CP, quantity produced in a batch after CP, Time consuming in a batch before CP, Time consuming in a batch after CP.
- b. Dependent Variables: Difference of Cost.

Coefficient^a

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
Constant)	3848.801	27496.400		-.140	.889		
Quantity produced in a batch before CP	.909	.008	.989	115.095	.000	.682	1.466
quantity produced in a batch after CP	74.454	5297.298	.000	.014	.989	.824	1.214
Time consuming in a batch before CP	-341.674	495.978	-.005	-.689	.492	.856	1.168
Time consuming in a batch after CP.	1440.416	9348.370	.014	1.543	.125	.626	1.597

- a. Dependent variable: difference of cost

Interpretation:

The table titled *Variables Entered/Removed* tells us about the independent variables and the regression method used. Here we can see that the independent variables are entered simultaneously for the analysis as we select the *Enter* method.

The next table titled *Model summary* gives us the R values for assessing the overall fit of the model. The adjusted R square in this case is 0.7866.

This tells us that the independent variables in our model account for 78.7% variance in the dependent variable.

The ANOVA gives the result of the analysis of the influence of selected independent variables on dependent variables.

The last table titled Coefficients gives the regression coefficients and their significance. These regression coefficients are used to construct an Ordinary Least Square equation.

Correlation analysis

When a bivariate population is under consideration, there is generally a need to study the simultaneous variation between two variables say X and Y. we know that the variation in a variable X is measured by

$$\sum(X - \bar{X})^2 \text{ and Y by } \sum(Y - \bar{Y})^2 .$$

Also the joint variation in X and Y is measured as $\sum(X - \bar{X})(Y - \bar{Y})$. We know, the three terms represent variance of X,Y and covariance between X and Y. so to obtain a measure of relation between X and Y independent of units of measurements. Karl Pearson in 1980 defined a measure of relationship given by formula.

$$\begin{aligned} \rho_{XY} &= \frac{\text{cov}(X, Y)}{\sqrt{\text{var}(X)\text{var}(Y)}} \\ &= \frac{\sum(X - \bar{X})(Y - \bar{Y})}{\sqrt{\sum(X - \bar{X})^2 \sum(Y - \bar{Y})^2}} \\ &= \frac{\rho_{XY}}{\rho_X \rho_Y} \\ &= \frac{\mu_{12}}{\sqrt{\mu_{11}\mu_{22}}} \end{aligned}$$

The measure of ρ_{XY} is called the product moment correlation co-efficient or simply correlation co-efficient.

The following table shows the details of the analysis

		Quantity of energy consumed before CP	Quantity of energy consumed after CP	Quantity of water consumed before CP	Quantity of water consumed after CP
Quantity of energy consumed before CP	Pearson correlation	1.000	0.725	0.624	0.76
	Significance (2-tailed)		0.000	0.000	0.387
Quantity of energy consumed after CP	Pearson correlation	0.725	1.000	0.467	0.129
	Significance (2-tailed)	0.000		0.000	0.029
Quantity of water consumed before CP	Pearson correlation	0.840	0.467	1.000	0.021
	Significance (2-tailed)	0.000	0.315		1.838
Quantity of water consumed after CP	Pearson correlation	0.467	0.129	0.021	1.000
	Significance (2-tailed)	0.387	0.003	0.838	

From the table above, it can be seen that the cleaner production is significantly correlated with the return on the assets as the P-value is less than 0.05

Chi-square Test for Independence of attributes

The chi-square test is a statistical tool that is used to test whether the observed frequencies are significantly differing from the expected frequencies.

The chi-square test of independence is used to test the hypothesis that two categorical variables are independent from each other.

An attribute may be marked by its presence or absence in a number of a given population. Let us consider two attributes A and B. A is divided into two classes (a, b) and B is divided into two classes (c, d). the various cell frequencies can be expressed in the following table known as a 2 x 2 contingency table.

A	a	B
B	c	D

Note: in this chi-square test, we test if two attributes A and B under consideration are independent or not.

Hypothesis:

H_0 : Attributes are independent

$$\chi^2 = \sum_{i=0}^n \frac{(O_i - E_i)^2}{O_i} \sim \chi^2_{\alpha} (r - 1)(s - 1)$$

Degree of freedom: d.f = (r - 1)(s - 1)

Where: r = number of rows

S = number of columns

Hence we are going to test whether,

There is any association between the cleaner production and profitability.

Hypothesis:

H_0 : There is no association between the cleaner production and profitability.

It is decided to check whether there is dependence between the cleaner production and profitability or not. For this purpose the data observed on cleaner production are classified in the form of three by two contingency table, taking the attributes cleaner production and profitability.

The results are as follows.

Expected values

Case	Effect on Cost of Materials	Effect on Profitability	Effect on Environment impact.	Row total
Yes	7.36	12.43	4.41	24.20
No	1.32	2.3	2.18	5.80
Col. total	8.68	14.73	6.59	30.00

Chi-square Test

	Value	df	Asymp. Sig (2-sides)
Pearson Chi-square	7.127	3	0.0380
Likelihood Ratio	7.119	3	0.0380
Linear-by- linear ass.	0.721	1	0.0432
N of valid case	30		

$$\chi^2 = 7.127$$

$$P = 0.0380$$

As the P-value is less than 0.05, the null hypothesis is rejected and hence it is concluded that there is association between cleaner production and profitability.

Testing Hypotheses

This section test the three hypotheses which are: Ho1: there is no significant effect of cleaner production (raw materials quantity, quantity produced, quality of the product, quantity of water& energy used) on material use intensity in selected tea factories in Rwanda, Ho2: Cleaner production (raw materials quantity, quantity produced, quality of the product, quantity of water& energy used) does not significantly affect the reduction of water and energy in selected tea factories in Rwanda, Ho3: Cleaner production (raw materials quantity, quantity produced, quality of the product, quantity of water& energy used) does not significantly affect the reduction of environment impact in selected tea factories in Rwanda.

Testing Hypothesis Ho1

Ho1: there is no significant effect of cleaner production (raw materials quantity, quantity produced, quality of the product, quantity of water& energy used) on material use intensity in selected tea factories in Rwanda.

The details of the results are given below

Variables Entered/Removed^b

Model	Variables Entered	Variables Removed	Method
1	raw materials quantity, quantity produced, quality of the product, quantity of water& energy used	X ₁ X ₂ X ₃ X ₄	Enter

- c. All requested variables entered
- d. Dependent variable: material use intensity

Model summary

Model	R	R square	Adjusted R square	Std. Error of the Estimate
1	.835 ^a	.70210	.70210	73845.386

b. Predictors: (Constant), x_1 , x_2 , x_3 , x_4

The adjusted R Square is .70210 representing 70.2% which means that the independent variables jointly affect the material use intensity.

ANOVA^b

Model	Sum of squares	Df	Mean square	F	Sig.
2 Regression	1.851E14	6	4.853E13	4912.776	.000a
Residual	1.786E12	175	9.877E9		
Total	1.810E14	181			

c. Predictors: (Constant), x_1 , x_2 , x_3 , x_4 .

d. Dependent variable: material use intensity

The F-test is positive and the fact it is significant at 5%, because its significance level is 0.000 Therefore, based on the results on this test, we reject the null hypothesis H_0 1 stating that “there is no significant effect of cleaner production (raw materials quantity, quantity produced, quality of the product, quantity of water& energy used) on material use intensity in selected tea factories in Rwanda.” We reject H_0 1 because the ANOVA table shows that there is a positive and significant effect on Material use intensity.

Coefficient^a

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Constant)	3768.801	27876.400		-.140	.889
X ₁	.808	.005	.808	115.095	.000
X ₂	84.874	5297.865	.000	.014	.000
X ₃	-391.464	496.787	-.005	-.689	.000
X ₄	1840.986	9348.986	.014	1.543	.000

b. Dependent material use intensity

The Coefficient table shows that all independent variables, x₁, x₂, x₃,x₄. Has a positive and significant effect on material use intensity, as p-value < 0.05

Testing Hypothesis Ho2

Ho2: Cleaner production (raw materials quantity, quantity produced, quality of the product, quantity of water& energy used) does not significantly affect the reduction of water and energy in selected tea factories in Rwanda

The details of the results are given below

Variables Entered/Removed^b

Model	Variables Entered	Variables Removed	Method
1	raw materials quantity, quantity produced, quality of the product, quantity of water& energy used	X ₁ X ₂ X ₃ X ₄	Enter

- e. All requested variables entered
- f. Dependent variable: quantity of water & energy

Model summary

Model	R	R square	Adjusted R square	Std. Error of the Estimate
1	.835 ^a	.80910	.80300	74745.386

- c. Predictors: (Constant), x₁ , x₂ ,x₃ , x₄

The adjusted R Square is .8030 representing 80.3% which means that the independent variables jointly affect the material use intensity.

ANOVA^b

Model		Sum of squares	Df	Mean square	F	Sig.
3	Regression	1.851E14	5	4.853E13	4912.776	.000a
	Residual	1.766E12	176	9.877E9		
	Total	1.810E14	181			

- e. Predictors: (Constant), x₁ , x₂ ,x₃ , x₄.
- f. Dependent variable: quantity of water & energy

The F-test is positive and the fact it is significant at 5%, because its significance level is 0.000 Therefore, based on the results on this test, we reject the null hypothesis Ho2 stating that “Cleaner production (raw materials quantity, quantity produced, quality of the product, quantity of water& energy used) does not significantly affect the reduction of water and energy in

selected tea factories in Rwanda.” We reject Ho2 because the ANOVA table shows that there is a positive and significant effect on Material use intensity.

Coefficient^a

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Constant)	-3768.801	27876.400		-.140	.889
X ₁	.808	.005	.808	115.095	.000
X ₂	84.874	5297.865	.000	.014	.000
X ₃	-391.464	496.787	-.005	-.689	.000
X ₄	1840.986	9348.986	.014	1.543	.000

c. Dependent quantity of water&energy

The Coefficient table shows that all independent variables, x1, x2, x3, x4. Has a positive and significant effect on quantity of water & energy, as p-value < 0.05

Testing Hypothesis Ho3

Ho3: Cleaner production (raw materials quantity, quantity produced, quality of the product, quantity of water& energy used) does not significantly affect the reduction of environment impact in selected tea factories in Rwanda

The details of the results are given below

Variables Entered/Removed^b

Model	Variables Entered	Variables Removed	Method
1	raw materials quantity, quantity produced, quality of the product, quantity of water& energy used	X ₁ X ₂ X ₃ X ₄	Enter

g. All requested variables entered

h. Dependent variable: environment impact

Model summary

Model	R	R square	Adjusted R square	Std. Error of the Estimate
1	.835 ^a	.70210	.70210	73845.386

d. Predictors: (Constant), X₁ , X₂ ,X₃ , X₄

The adjusted R Square is .70210 representing 70.2% which means that the independent variables jointly affect the environment impact.

ANOVA^b

Model		Sum of squares	Df	Mean square	F	Sig.
4	Regression	1.851E14	6	4.853E13	4912.776	.000a
	Residual	1.786E12	175	9.877E9		
	Total	1.810E14	181			

g. Predictors: (Constant), X₁ , X₂ ,X₃ , X₄.

h. Dependent variable: environment impact

The F-test is positive and the fact it is significant at 5%, because its significance level is 0.000 Therefore, based on the results on this test, we reject the null hypothesis Ho3 stating that “Cleaner production (raw materials quantity, quantity produced, quality of the product, quantity

of water& energy used) does not significantly affect the reduction of environment impact in selected tea factories in Rwanda

Coefficient^a

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Constant)	3768.801	27876.400		-.140	.889
X ₁	.808	.005	.808	115.095	.000
X ₂	84.874	5297.865	.000	.014	.000
X ₃	-391.464	496.787	-.005	-.689	.000
X ₄	1840.986	9348.986	.014	1.543	.000

d. Dependent environment impact

The Coefficient table shows that all independent variables, x₁, x₂, x₃,x₄. Has a positive and significant effect on environment impact, as p-value < 0.05

Additional analysis to enrich the project’s results

This point presents the results related to the objective of the study which gathered from the questionnaire and also from interview while conducting this research.

Table 12: Cleaner Production and Environment Conservation

	Frequency	Percent (%)
Strongly Agree	23	76.7
Agree	5	16.7
Not Agree	2	6.6
Disagree	0	0
Total	30	100

Researcher, 2019

In the table 12 the results showed that 76.7% strongly agree that the cleaner production project were contributed to the environment conservation, 16.7% of the respondents agreed with the statement, 6.6% not agree while no one of the respondents disagreed with the statement. It means that the staff who have initiated the cleaner production project in those four factories knew the positive impact of the cleaner production on the environment. An eco-efficient factory understands and seeks to minimize the environmental impact of its products throughout their life cycles. Such factory provided added value from their activities by monitoring and assessing their impact at every stage. Assessing environmental impacts for cleaner products assisted factories in their quest for continuous improvement by identifying ways of maximizing profits through reducing waste and liabilities, raising productivity and demonstrating the company's sense of responsibility towards the environment.

Table 13: Cleaner Production and Profitability

	Frequency	Percent (%)
Strongly Agree	28	93.3
Agree	2	6.7
Not Agree	0	0
Disagree	0	0
Total	30	100

Researcher, 2019

The table 13 the results showed that 93.3% of the total respondents strongly agreed with the profitability, 6.7% of the total respondents agreed that the cleaner production contributes to the profitability of the tea factories while no one have responded negatively. It means that the total number of respondents knows the importance of cleaner production project on tea factories' savings and profitability.

Table 14: Relationship Between Cleaner Production and Profitability

	Frequency	Percent (%)
Strongly Agree	30	100
Agree	0	0
Not Agree	0	0
Disagree	0	0
Total	30	100

Researcher, 2019

The table 14 above shows the relationship between the cleaner production and profitability where the totality of the respondents (100%) was strongly agreed that there is a strong correlation between cleaner production and profitability of tea factories.

4.2 Results and Discussion

This chapter four covered the presentation of the results from the interview and questionnaire. The results presented in three parts, part one was covered the demographic of respondents, results from the secondary data and the results from the questionnaire. About the demographic including gender the results showed that 66.4% were male while 33.% were female which means that it was a gender balance in those three tea factories; about age the majority of the respondents ranged between 41-50 years old which means that they were mature to understand well the function of the tea companies; about the status, it was shown that above 66% of the respondents are married which means that they allowed to be charged the high job tasks in the project because they had permanent address greater than other status of respondents; about the education

level of the respondents, a half of the respondents 50% had masters degree 20% had bachelor degree and 16% had PhD, it means that the majority of respondents had a highest degree which means that most of respondents had managerial skills important to the good performance of cleaner production project. About experience of the respondents, around 70% of the respondents had 7-11 years and above, which means that they had enough skills to maintain the project profitability. The second part of this chapter have present the results from secondary data where the results showed the different between the investment and cost saving in three tea factories (Kitabi, Mata and Nyabihu) before and after cleaner production project. Starting on Kitabi tea factory, before CP the total investment made in energy, water, wood and technology were 50,015 UDA and cost saved were 99,143 USD while after CP the factory invested 36,180 USD and saved cost equal to 109,620 USD, it means that after the cleaner production project at Kitabi tea factory has saved more after introducing Cleaner production project in the factory. Before CP the company invested more and saved less which means there is a loss while after CP Kitabi invested less money and saved much money, where the factory profited after CP project.

Before CP, Mata tea factory has invested total amount of 116,707 USD and saved 74,590 USD while after CP the factory invested 82,672 USD and saved 152,727 USD. After CP the company saved more because it has reduced the consumption of electricity, water, wood and technology.

According to the result, Nyabihu Tea Factory made a highest investment among the other two factories before CP project, where it has invested the total 915,707 USD and saved 478,833 USD while after CP 712,547 USD and saved 840,327 USD. This means that Nyabihu tea factory has also the benefits after CP it has invested less money and saved more money after reducing the cost of water, energy, wood and technologies used after the introduction of cleaner production process in Nyabihu tea factory.

About the Return On Asset (ROA), it has been shown in the table 4.9 and 4.10. Where the comparison showed that each franc invested after cleaner production project in all those three tea factories has make double comparing to each franc invested before cleaner production project. It means that all threes tea factories profited after introducing CP project.

The results related to the objective, the respondents showed that the cleaner production and environment have a relationship, 76.7% strongly agreed, 16.7% agreed while only 6.6% not

agreed. In the table 13 and 14 the majority of the respondents assumed that cleaner production and profitability in those three tea factories are positively related.

CHAPTER FIVE

SUMMARY, FINDINGS, CONCLUSION AND RECOMMENDATION

5.1. Major Findings

This chapter presents the findings, conclusion and recommendations based on the research objectives.

Objective one of this research was to evaluate the difference in cost of materials that was used before and after cleaner production:

It was shown in the table 4.7 at KITABI tea Factory that it improving its power factor to avoid the penalties in electricity bills payment and the company has been able to change power factor from 0.78 in 2015 to 0.91 in 2018. The savings recorded were almost 55,820 \$ after cleaner production project. It has also invested in replacing the 400 fluorescent tube lights of 40watts to LED (Light Emitted Diode) of 16watts. Annual Resource Efficient and Cleaner Production (RECP) benefits were US \$ 45,259 saved through energy efficiency against USD 14,899 before cleaner production, while after the cleaner production period the factory invested less amount 10,365 \$ and get more saving of 55,820 \$.

In MATA tea Factory has reduced in firewood from 3.8 to 3.2 stere/ton of making tea (0.6 stere reduction per ton) for an average of 2,000 tons per year, saving were 1,200 stere per year and two acres

saved per year. About water it has reduced the consumption of water from 600m³ per year, 1,500m³ of treated wastewater reused in farming. It has also reduced the energy consumption for lighting by de-lamping non-working light.

About NYABIHU tea Factory, Before the introduction of cleaner production, the factory in energy has invested 266,155 \$ and saved 170,350 \$ while after using cleaner production system the factory has invested less than before 215,365 \$ and saved 270,453 \$ which means that during the cleaner production the NYABIHU Tea Factory has gained more comparing to the previous years. In water, the company has invested 136,310 \$ and saved 92,540 \$ before the adoption of cleaner production, where after cleaner production the factory has invested 85,520 \$ and saved

99,548 \$. It means that the factory water investment has gained because after the using of cleaner production, it has invested less money and saved more money comparing to the previous years.

The second objective of the study was to determine the impact of cleaner production on the return on assets

The findings in the table 4.10 showed that before showed the ROA before the implementation of Cleaner project in those three tea factories, where in Kitabi tea factory each dollar invested in asset have generated 8.3% of net income, in Mata tea factory each dollar invested have generated 7.7% of net income and in Nyabihu Tea Factory each dollar invested have generated 12.5% while after due to cleaner production investment in the three tea factories, they have taken a hit in the level of profits generated. Where every dollar that Kitabi tea factory's has invested in assets after implementation of cleaner project, it has generated 16% of net income which was a round of a double before the implementation of that project; each dollar invested has generated 6.3% on net income. About Mata tea factory, each dollar that invested after cleaner production project was generating 13.1% of net income while before the project each dollar invested has generating 7.7% and finally in Nyabihu tea factory on each dollar invested after cleaner production implementation project it was generated 17.2% while before the project each dollar invested has generated 12.5%.

The results showed that all three tea factories benefited after implementing the cleaner production project.

The third objective of the study was to determine the relationship between cleaner production and profitability

The results in the table 13 the results showed that 93.3% of the total respondents strongly agreed with the profitability, 6.7% of the total respondents agreed that the cleaner production contributes to the profitability of the tea factories while no one have responded negatively. It means that the total number of respondents knows the importance of cleaner production project on tea factories' savings and profitability, and finally in the table 14 shows the relationship between the cleaner production and profitability where the totality of the respondents (100%) was strongly agreed that there is a strong correlation between cleaner production and profitability of tea factories.

According to the results of questionnaire and interview with the respondents, there are some reasons to invest in Cleaner Production like improvements to product and processes; savings on raw materials and energy, thus diminishing production costs; expanded competitiveness through the utilize of modern and moved forward innovations; diminished concerns over environmental legislation; decreased risk related with the treatment, storage and disposal of dangerous wastes; improved wellbeing, security and morale of employees; improved company image and diminished costs of materials utilized. In addition they claims that Cleaner Production can diminish or eliminate the need to trade off environmental protection against economic growth, word related security against productivity, and consumer security against competition in international markets. Setting goals over a extend of sustainability issues. Hence, Cleaner Production can be considered as strategy which was protected the environment additionally improving industrial sector.

5.2. Conclusion

This research has disclosed that Cleaner Production has provided the opportunities to the tea factories to improve their environmental management performance and saving in operation and products cost. Requirement in environmental protection and the increasing demand for natural resources was known as the main driving force for the implementation of CP. Awareness of global activities was essential to ensure the success of the business for a long term. CP can be accomplished through various area of translational process in order to obtain the optimum impact hence lead for better sustainable tea producing practice. Different factories produced a different effect of the CP implementation. From literature, it has shown that the implementation of CP can provide a numerous beneficial impact such as increase recyclability, using less energy consumption, reduce the pollution emission of substances, produce less amount of waste, nominal use of natural resources, nominal use of packaging material, decrease raw material usage, better safety practice, avoid penalties of electricity, proactive in preventing pollution and bring blaze intention force for the innovation. All the beneficial impacts increased the level of environmental, economic and competency performances which was the key elements in sustainable tea factories saving and profitability.

5.3. Recommendations

Further works might reveal more benefits that can be derived from the implementation of CP and influence the level of sustainable manufacturing practice.

The dominant factors such as types of business, adoption of proper translational process and obstacles encountered can provide better information that can be used by manufacturing firms in determining the appropriate strategies that should be used for optimum results.

Using this information, a field study should be carried out accurately and comprehensively to achieve a better result at high level of performance.

REFERENCES

- Bommel, M. (2011) A conceptual framework for analyzing sustainability strategies in industrial supply networks from an innovation perspective, *Journal of Cleaner Production*, pp 5-10.
- Brien, D. (1999) Sustainable production a new paradigm for a new millennium, *International Journal of Production Economics*, Vol. 60.
- Byggeth, G. Broman (2011) *A method for sustainable product development based on a modular system of guiding questions*, *Journal of Cleaner Production*, Vol. 15.
- Chiang, D. (2007) Prioritization of competitive priority in cleaner production implementation, *2007 IEEE International Conference on Industrial Engineering and Engineering Management*, pp. 104.
- Chiu, M. (2009) Fuzzy AHP-based study of cleaner production implementation in Taiwan PWB manufacturer," *Journal of Cleaner Production*, Vol. 17, No. 14, pp. 1249–1256.
- Chompu-inwai, M. (2010) Application of Cleaner Technology and experimental design for the reduction of chemical substance consumption in the hard disk drive arm coil assembly process, *The 40th International Conference on Computers & Industrial Engineering*, pp. 1–6.
- Dan, Z. (2013) An analysis of the original driving forces behind the promotion of compulsory cleaner production assessment in key enterprises of China, *Journal of Cleaner Production*, 46.
- Delano, R. (2013) Valued platform to illustrate impact and profitability of RECP program. *Cleaner Production Conference*.
- Dieleman, K. (2000) Cleaner Production and Innovation Theory. *Social Experiments As A New Model To Engage In Cleaner Production*, *Rev. Int. Contam. Ambient*, Vol. 23.

- Doniec, J. (2005) Assessment of the potential of cleaner production implementation in Polish enterprises, *Journal of Cleaner Production*, Vol. 10.
- Garrett, J. (2009) Market responsiveness, top management risk taking, and the role of strategic learning as determinants of market pioneering,” *Journal of Business Research*, Vol. 62.
- Geiser, K. (2005) Cleaner production perspectives for the next decade (I). *UNEP’s 6th international high - level seminar on cleaner production, Montreal, Canada, Oct. 2000.*
- Hai-Song (2009), Simulation Research on the Driving Factors of Clean Production Based on the System Dynamics, *International Conference on Information Management, Innovation Management and Industrial Engineering*, pp. 266.
- Huang, Y. (2006), A case study on artificial intelligence based cleaner production evaluation system for surface treatment facilities, *Journal of Cleaner Production*, Vol. 14.
- Hicks, C. (2002) Improving cleaner production through the application of environmental management tools in China, *Journal of Cleaner Production*, Vol. 15, No. 5.
- Kambani, H. (2003), Small-scale mining and cleaner production issues in Zambia, *Journal of Cleaner Production*, Vol. 11.
- Mat, E. (2015) Cleaner production in Danish fish processing experiences, status and possible future strategies, *Journal of Cleaner Production*, Vol. 17.
- Gombault, M. (1999), Cleaner production in SMEs through a partnership with (local) authorities: successes from the Netherlands, *Journal of Cleaner Production*, Vol. 7.
- Moors, K. (2001), Towards cleaner production: barriers and strategies in the base metals producing industry, *Journal of Cleaner Production*, Vol. 13, No. 7, pp. 657–668, Jun. 2005.

- Moutaqi, G. (2009) Cleaner production in the management of water use at a poultry slaughterhouse of Vale do Taquari, Brazil: a case study, *Journal of Cleaner Production*, Vol. 17.
- Nosrat, K. (2009) Cleaner Production via Industrial Symbiosis in Glass and Large Scale Solar Photovoltaic Manufacturing, *Toronto International Conference Science and Technology for Humanity (TIC-STH)*, pp. 967.
- Rivera, T. (2011) Barriers to the adoption of proactive environmental strategies, *Journal of Cleaner Production*, Vol. 1.
- Zeng, X. (2010) Impact of cleaner production on business performance, *Journal of Cleaner Production*, Vol. 18.
- Salvador, J. (2002) Cleaner Production and Environmental Impact Assessment: a UK perspective, *Journal of Cleaner Production*, pp. 127–132,
- Schaffartzik, A. (2014) The global metabolic transition: Regional patterns and trends of global material flows, 1950–2010. *Global Environmental Change*, pp 87-97.
- Schandl, H., (2016) Decoupling global environmental pressure and economic growth: scenarios for energy use, materials use and carbon emissions, *Journal of Cleaner Production*, 132: 45.
- Shi, H. (2008) Barriers to the implementation of cleaner production in Chinese SMEs: government, industry and expert stakeholders' perspectives, *Journal of Cleaner Production*, 16(7): 842-852.
- Qian, Y. (2002) The review and perspective of cleaner production promotion in China, *China Population, Resources and Environment*, , 12(2): 121-124
- Dobes, V. (2013) New tool for promotion of energy management and cleaner production on no cure, no pay basis, *Journal of Cleaner Production*, Vol. 39, pp. 255–264, Jan. 2013. *Journal of Advanced Manufacturing Technology*.

- Berkel, R. (2000) Cleaner Production Perspectives for the Next Decade (II), *UNEP's 6th International High - Level Seminar on Cleaner Production, Montreal, Canada.*
- Vieira, C. (2016) Barriers and strategies applying Cleaner Production: a systematic review. *Journal of Cleaner Production, , 113: 5-16.*
- Xiaohong, F. (2012), The research on a new cleaner production model for flying ash aerated concrete production, *2012 24th Chinese Control and Decision Conference (CCDC), pp. 429.*
- Wan, M. (2010) Implementation of 5S Practices in the Manufacturing Companies: A Case Study, *American Journal of Applied Sciences, ISSN 1546-9239, Vol. 7.*
- Wang, H. (2014) Exploring China's Materialization Process with Economic Transition: Analysis of Raw Material Consumption and Its Socioeconomic Drivers, *Environmental Science & Technology, 48(9): 5025-5032*
- Yüksel, P, (2008) An empirical evaluation of cleaner production practices in Turkey, *Journal of Cleaner Production, pp. S50–S57, Jan. 2008.*

APPENDIX

APPENDIX 1: QUESTIONNAIRE

Dear Respondent,

I am **Jackie UWIZEYE** an MBA student in the University of Rwanda. I am doing a research aimed at collecting information to assist me in the research. All information will be given to me will be private and will be confidentiality and will be used for the purpose of this research only.

PART 1: GENERAL INFORMATION

1. Gender:

Male

Female

2. Age group:

a. 20-30

b. 31-40

c. 41-50

d. 51 and over

3. Marital status

a. Married

b. Single

c. Widow

3. Education Background

a. PhD

b. Master's Degree

c. Bachelor's Degree

d. Secondary Level

e. Primary Level

f. None Education

4. Experience of working in Tea factories

- a. One
- b. Two Years
- c. Three Years
- d. Four Years & above

PART TWO: QUESTIONS RELATED TO THE OBJECTIVES

5. Does cleaner production project contributed on environmental conservation?

- (i) Strongly agree
- (ii) Agree
- (iii) Not agree
- (iv) Disagree

If yes, explain it?.....

.....

6. How much quantity of energy was used by your factory before and after cleaner production project?

7. How much quantity of water was used by your factory before and after cleaner production project?

8. What is the cost of the material used before and after cleaner production project?

9. Is there some profit since the implementation of cleaner production in your factory?

- (i) Strongly agree
- (ii) Agree
- (iii) Strongly not agree

(iv) Not agree []

10. What is the return on asset of your factory?

11. Is there some relationship between cleaner production and profitability of your factory?

12. If yes or not, explain?.....

.....

Thesis Jackie UWIZEYE

ORIGINALITY REPORT

17%

SIMILARITY INDEX

9%

INTERNET SOURCES

4%

PUBLICATIONS

14%

STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to Mount Kenya University Student Paper	5%
2	www.advancesincleanerproduction.net Internet Source	2%
3	rwandamountaintea.com Internet Source	1%
4	cleantechinitiative.com Internet Source	1%
5	Submitted to Ghana Technology University College Student Paper	1%
6	Submitted to Shinas College of Technology Student Paper	1%
7	Submitted to University of South Africa Student Paper	<1%
8	cleanerproduction.curtin.edu.au Internet Source	<1%
9	"Sustainable Manufacturing", Springer Nature,	