ANALYSIS OF THE IMPACT OF ANNUAL WORKPLAN AND BUDGET PROCESSES ON PERFORMANCE OF COUNTY FOREST CONSERVANCIES IN KENYA

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2025

DECLARATION

Declaration by the Candidate

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DEDICATION

This work is dedicated to my beloved wife Everlyne and children Melyn, Mildred, Mitchelle and Morgan who accorded me love, courage, inspiration and moral support throughout this period in pursuit of the study.

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ABSTRACT

Annual Workplan and Budget (AWP&B) are documents prepared annually by public organizations as required by the government policy for funds allocation by the treasury. It presents financial needs of an organization and the activities to be implemented in a given financial year. However, funds allocated to public organizations usually do not normally meet the threshold of the presented AWP&B for many organizations. There is normally a deficit in the funds allocated. This financial deficit therefore necessitates a strong enabling AWP&B to enhance negotiation of more funds from the exchequer. One glaring issue is that the allocating committees of treasury may not prioritize the activities of the organization highly and thus may allocate very little funds. Meanwhile, as all public organizations vie for the same 'basket of funds', there is need for strong presentation to ensure enough funds are given to an organization. This study analyzed the impact of AWP&B processes on performance of County Forest Conservancies (CFCs) in Kenya. Specifically, the study determined conformity of the amalgamated AWP&B of Kenya Forest Service (KFS) to requirement by the treasury as stipulated in Medium Term Budget (MTB) process for funds allocation from the exchequer, evaluated the performance of CFCs against their Performance Contract (PC) targets as indicated in their AWP&B, derived correlation between funds allocation and performance of CFCs and formulated AWP&B structure that will be effective and efficient to negotiate for more funds from the exchequer and enable attainment of PC targets. 17 Counties were sampled out of a population of 47 and inferential statistics employed in the analysis. Findings on objective one showed some non-conformities resulting to ineffective negotiations for adequate fund allocation to KFS by the Treasury. On performance evaluation, Chi-square ($\chi 2$) test statistics results showed that the calculated value (79.81) was greater than the critical value (5.99) at 95% ($\alpha = 0.05$) implying significant differences between CFCs performance and expectations. Results on objective three using Linear Programming (LP) model (L&IP Software on optimization) provided optimal solution on performance for positive output. In conclusion, the study noted that improved AWP&B will enhance effective and efficient base for negotiation for more funds from the exchequer and increase the level of satisfaction of performance of activities done by the CFCs. In recommendation, the management to put in place effective and efficient AWP&B (by continuously looking at outputs vs inputs) that will fully conform to requirement by the treasury guidelines for funds allocation and actively engage exchequer for increased funding level base for delivery of AWP&B.

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LIST OF ABBREVIATIONS, ACRONYMS AND SYMBOLS

ABBREVIATIONS AND ACRONYMS

A.I.A	Appropriation in Aid
ARA	Annual Report Appraisal
AWP&B	Annual Work Plan and Budget
BPS	Budget Policy Statement
CFA	Community Forest Association
CFCs	County Forest Conservancies
CI	Critical Value
DV	Decision Variables
EFT	Electronic Fund Transfer
ERS	Economic Recovery Strategy
FAO	Food and Agriculture Organization
FCM	Forest Conservation Management
FFYs	Fiscal Financial Years
FY	Financial Year
GDF	Gross Domestic Fund
GDP	Gross Domestic Product
GFRA	Global Forest Resource Assessment
GFS	Government Financial Statistics
GOK	Government of Kenya
IMF	International Monetary Fund

KFS	Kenya Forest Service
KPI	Key Performance Indicator
LIB	Line Item Budgeting
L&IP	Linear and Integer Programming
LP	Linear Programming
MDAs	Ministry, Departments and Agencies
M&E	Monitoring and Evaluation
MRA	Monthly Report Appraisal
MTB	Medium Term Budget
MTEF	Medium Term Expenditure Framework
MTP	Medium Term Plan
NFP	National Forestry Programme
NTFP	Non Timber Forest Products
OF	Objective Function
PCs	Performance Contracts
PELIS	Plantation Establishment and Livelihood Improvement Scheme
PPRs	Programme Performance Reviews
QRA	Quarterly Report Appraisal
RFCs	Regional Forest Conservancies
RRI	Rapid Results Initiative
SMART	Specific, Measurable, Achievable, Realistic and Time bound
SFM	Sustainable Forest Management

SP	Strategic Plan
SPI	Satisfaction on Performance Indicator
SWGs	Small Working Groups
UNDG	United Nations Development Group
UoE	University of Eldoret

SYMBOLS

α	Critical region of error
$C_1, C_2 \ldots C_{11}$	The Constraints
f_e	Expected value of categorical variable
f_o	Expected value of categorical variable
k	Number of categories on satisfaction assessment
p	Probability
$X_1, X_2 \ldots X_7$	Decisions variables
χ^2	Critical value of Chi-square test of independence
(*x*, *y*, *z*)	Dependent variables
v	Degree of freedom
Z	The objective function of Linear Programming model of optimization
(.)	Optimum point at the intersection of feasible region in the graph
≥ / > =	Greater than or equal to
≤ / < =	Less than or equal to

OPERATIONALIZATION OF TERMS

Analysis: The process of systematically applying statistical techniques and logic to interpret, compare, categorize, and summarize data collected in order to draw conclusions on the impact of annual work plan and budget processes on performance of County Forest Conservancies in Kenya.

Annual work Plan and Budget (AWP&B): The process by which an organization estimates its finances and set out activities to be implemented within the financial year in line with the organization strategic plan, policy decisions by the board and the blue print of vision 2030 and it forms accountability for organization in carrying out its duties, functions and authority. It identifies costed & funded activities within financial year to be implemented ceteris paribus.

Assessment: Evaluation of the quality of the study and decide or fix the value of phenomenon by identifying and analyzing problems and giving solutions which form the basis of an activity.

Budget: A government annual statement of proposed expenditure and revenues. The budget is submitted to parliament which authorizes expenditure by approving an Appropriation Act.

Budgetary Unit: A Ministry, Department or Agency who prepares the medium-term budget guided by the circulars from the National Treasury and Planning.

Chi-square (χ^2): An analysis of the descriptive data measuring discrepancy between expected and obtained frequencies of performance.

Constraints: Requirements or restrictions placed on the firm by the operating environment, stated in linear relationships of the decision variables.

Decision Variables (DV): Are components that can change when solving the linear program. These are quantities that the program is trying to determine to solve the problem.

Efficiency: A measure of how economically or optimally inputs in terms of financial, human, technical and material resources are used to produce outputs.

Effectiveness: A measure of the extent to which a project attains its objectives at the goals or purpose level. That is the extent to which an interaction has attained, or is expected to attain its relevant objectives efficiency and in a sustainable way.

Framework: A set of procedural guidelines, requirements, rules, ideas which are used for the medium-term budget negotiation in order to deal with problems of resource allocation.

Framework strategy: Is a strategic method used to define how the treasury supports the key objectives of the AWP&B to facilitate the negotiation of funds allocation from the exchequer.

Key Performance Indicators (KPI): A variable that adequately demonstrates that the changes desired from a development intervention have been achieved.

Linear Programming (LP): Optimization model maximizing or minimizing a linear objective function subject to linear constraints where objective function represents what you want to optimize like profit, cost, efficiency while the constraints define limitations like budget, production capacity, time.

Line Item Budgeting (LIB): A financial document that lists how much will be spent on every item included in the budget. It is a simple and broadly used budgeting system that is primarily concerned with the control of aggregate government spending limits.

Medium Term Budget (MTB): A financial plan that estimates the expenditures and revenues of state for the next fiscal financial year linking Government objective and other resources to the public policy objective and it require effectiveness measures of the outputs and outcomes for fund allocation to public sectors.

Negotiation: A strategic discussion that resolves the budget proposals by programmes in the medium-term budget period in a way that both parties find acceptable resolution in the resource allocation.

Objective Function (OF): Is the valued function in a mathematical optimization problem where value is to be either minimized or maximized over the set of feasible alternatives.

Optimization: This is an approach used to find the combination of inputs to achieve the best possible output subject to satisfying certain prespecified constraints and conditions. e.g. utilization of allocated fund for workforce planning. The primary goal of the optimization process is to eliminate waste and reduce costs.

Outcome: The intended or achieved effects of an interventions outputs of the intermediate results generated relative to the objective of the interventions.

Outputs: Goods or services produced by an activity. An example is, number of seedling production.

Parameters: Are numerical coefficients and constants used in the objective function and constraints.

Performance: A presentation of an outstanding action or achievement of AWP&B of an organization.

Performance Contract (PC): A specification of the mutual performance obligations, intentions, commitments and responsibilities for agreed performance targets for the financial year between the two contracting parties. It assigns accountability for AWP&B targets.

Programme: A grouping of Ministry, Department or Agency functions according to a key objective, based on the main functions performed or services delivered.

Results: The measurable output, outcome or impact of intended, unintended, positive and /or negative derived from a cause-and-effect relationship set in motion by a development intervention.

Slack variables: Additional variables that are introduced into the linear constraints of a linear programming to transform them from inequality constraints to equality constraints. These are difference between the right-hand side and left-hand side of a constraints.

Strategic Plans: Translate institutional goals into 5-year sectoral objectives from the long-term national plans.

System optimization: A function that essentially seeks to minimize the total fixed and variable costs to the performance of the organization activities and ensure effective and efficient deployment of existing resources for capability maximization.

CHAPTER ONE

INTRODUCTION

1.1 Introduction

This chapter presents an introduction of this study. It begins by describing the background information of the study, the statement of the problem, research objectives, main objective, specific objectives and research questions. The chapter also presents the justification, scope, limitations and assumptions of the study.

1.2 Background Information of the study

Globally forestry is crucial to the lives of millions of people, especially the poorest of the society who most critically depend on forest resources for their well-being and survival in the absence of other livelihood assets and opportunities (FAO, 2024). The State of the World's Forests highlights that the formal forest sector contributes more than USD 1.5 trillion to national economies globally with forests (FAO, 2022).

Regionally, the forest sector plays a critical role in the national economy, contributing 3.6% to the Gross Domestic Product (GDP) worth Kenya shillings 7 billion (FAO, 2022). According to GOK, (2018) it employs over 50,000 people directly and another 300,000 indirectly therefore it is key to Kenya's social and economic well-being as most of the country's economic sectors rely on forest resource base for sustenance.

Kottut *et al*. (2019) observed that forest resources have a significant role in alleviating household poverty and as such organizations have the responsibility to formulate governance structures and policies that enhance effective and efficient conservation and management of her forest resources. Thus, the action of the milestone achievement will be embedding on sustainable household livelihood outcomes (Kottut *et al.,* 2019). In order for the forest sector to contribute significantly to sustainable development, there is a need for countries to practice Sustainable Forest Management (SFM) i.e., to adopt an inter-sectoral approach to optimize benefits from forests to meet society's needs in a way that conserves and maintains forest ecosystems for present and future generations (Kottut et al., 2019).

Nationally, Kenya Forest Service (KFS) is a government organization mandated to provide for the development and sustainable management, including conservation and rational utilization of all forest resources for the socio-economic development of the country and for connected purposes is currently undergoing multidimensional reforms (GOK, 2016). These reforms are to spear head strategies with other stakeholders and private partners to improve effectiveness and efficiency on her work performance to attain the recommended minimum global standard of 10 percent forest cover which is the amount of forest covering the land (KFS, 2023). This observation is supported by the Constitution of Kenya GOK (2010) that requires Kenya to achieve and maintain a forest cover of at least ten percent to enhance sustainable development. Article 69 (1) (b) of this Constitution of Kenya GOK (2010) emphasizes the need to ‘‘work to achieve and

maintain a forest cover of at least ten percent of the land area of Kenya". The blueprint Kenya vision 2030 also set a goal for the country to increase the area under trees to ten per cent by 2030 (GOK, 2007). It stresses the need of sustainable management of natural forests to achieve enhanced environmental protection and economic growth.

The national forest cover in Kenya was estimated at 7.2 per cent based on the national projection according to the Global Forest Resource Assessment Report (GFRA), 2015 (FAO, 2015). However, the forest sector realized a milestone achievement and currently the forest cover was determined by National Forest Resources Assessment Report 2021 to be at 8.83% and the tree cover at 12.13% (KFS, 2021). The current results of the forest and tree cover milestone achievement now set a new bar for the country that will ensure government commitments in maintaining the requirement. The National Forest Resources Assessment Report (KFS, 2021) provides essential information of allocation of more fund from exchequer for tree planting programmes at the national levels.

Annual Work Plan and Budget (AWP&B) implemented in the County Forest Conservancies (CFCs), which is the study area, presents a new focus, role and a clearly determined direction to enhance the work performance in the county (GOK, 2024). The AWP&B system framework specifies strategies to be undertaken, resources required to facilitate its delivery, stakeholders that will be co-opted and necessary improvement in order to achieve strategic plan goals and objectives of the sector (GOK, 2024). The AWP&B therefore represents a formal, structured approach to achieve objectives and to

implement the corporate strategy of an organization and a basis for fund provision negotiations from central government (UNDG, 2024). The AWP&B is the process by which an organization estimates its finances and set out activities to be implemented within the financial year in line with the organization strategic plan, policy decisions by the board and the blue print of vision 2030 (GOK, 2024).

A well-defined AWP&B significantly impact organization performance by facilitating efficient resource allocation, promoting accountability and enabling effective Monitoring and reporting (GOK, 2024). A comprehensive work plan outlines the steps needed to achieve performance, targets set while budget provides the financial framework for these activities. Thus, AWP&B forms accountability for organization in carrying out its duties, functions and authority. It is from the Programme Performance Reviews (PPRs) of AWP&B results that forms the basis of economic growth and enables KFS to identify and prioritize the drivers and enablers to be included in budget proposals framework for negotiations of funds in the MTB process (GOK, 2024). Other intervention for funds provisions according to the Circular Guideline for preparation of the 2024/25-2026/27 MTB (GOK, 2024) are the initiation of zero-based budget to create fiscal financial space for the government agenda, declaring the financial resource required for individual programmes and projects and the level of provision within the budget ceilings provided and justifying each proposed programme funding within supporting documentation (GOK, 2024).

Levinson (2018) described AWP&B as creating a strategy for meeting organization goals and improving the business, a road map that lays out organization's plan of action and focuses on achievable goals for sustainable resource management. According to Sankei *et al.* (2020) the alignment of organizational structure significantly determines the performance of the organization and recommended the alignment of variables to organization strategy to enhance performance. Whereas as the strategy of AWP&B system estimates finances for a future period and plans its operations accordingly as observed by Koening (2005) the system provides a set of guidelines for top management to describe each department's role in achieving goals and objectives in the organization (Gubbins, 2003). In most global public sectors, the AWP&B production has been condensed to an event itself. While the AWP&B is considered an important driver of performance enhancement and as a source of information for budgeting and as a guide to attain the Performance Contracts (PCs) target commitments, it is in the process where real performance improvement can be found in the choices, decisions and resource allocations made by the top management (ADB, 2012).

Aprillia Nilasari *et al*. (2024) research on work planning and budget performance indicated that it is an embodiment of the principles of state financial reforms which is not fully being implemented. These reflects signs that that budget absorption is not being used efficiently as possible, with attention still being directed toward the financial year. In this regard the benefit of fund provided by the government is normally allegedly delayed as a result thereby affecting the overall implementation of activities. (Aprillia

Nilasari et al., 2024). Effective work planning and budget therefore can help organizations achieve financial goals, allocate resources effectively, and evaluate performance by continuously looking at outputs vs inputs and increase the ability to manage resources effectively and achieve desired outcomes.

In Kenya, the amalgamated AWP&B of KFS satisfies basic need of ease of doing business to achieve the organization's strategic plan goal and objectives while at the national level it plays decisive role of policy placement to enforce the implementation of the Forest Conservation and Management Act (GOK, 2016). The main function of AWP&B is therefore to ensure outputs concur with outcomes, closed output performance gaps and deliver improved performance on the negotiated, vetted and finally signed PCs by the Ministries, Department and Agencies (MDAs) are cascaded to all officers in various respective positions (GOK 2024). The legacy created by preceding PC targets expectations presents a core challenge in implementation of performance improvement through AWP&B (GOK, 2023). This is because of the assumed principles of work performance which are assimilated by the staff and are further underpinned by a structure of believes, values, attitudes cultures and decisions as stated in the Kenya Forest Service strategic plan (KFS, 2023).

In most organizations the aspects of AWP&B system tend to be largely considered as constrained tool used to perform the work. However, recent research findings stress that inefficient system should be perceived as opportunity to improve instead of a weakness

(Lemmens, *et al.,* 2006). Therefore, AWP&B fail to give a competitive edge as planned to qualify for requested fund allocation from central government. In the process the adhoc business as usual tends to prevail in the circumstances and miss the mark to realize the results as anticipated by the implementers (Lemmens, et al., 2006). However, the costs, benefits, characteristics and pitfalls related to amalgamated AWP&B of KFS and in-depth M&E have a result-oriented chain illustrating work performance, accountability and transparency that ensure enhanced fiscal outcomes. The identified challenges and developed mechanisms competitive for crucial improvement of the KFS sector performance is a perquisite for enhanced achievement. AWP&B is a major system that contributes into enhancement of work performance of an organization. Several studies have appraised the impact of AWP&B system as an enabler on work performance (Lambe, 2014). According to Allen (2013) it is possible to improve the work performance with the inducement of optimization of the modelled system. However, the results of optimization system will show great variation in the degree of success depending on the Key Performance Indicators (KPI) of the activities being implemented.

In this area of study, the AWP&B on performance of CFCs in Kenya republic were analyzed with regard to inducement of modelled system optimization with application of Linear Programming (LP) which essentially seek to minimize the total fixed and variable costs to the work performance of the activities implemented. The system allowed the implementer to maximize the benefits associated with an effective budget. This ensured formulation of AWP&B that will be effective and efficient to negotiate for more funds

from exchequer and enable attainment of PCs targets by CFCs. Zohreh *et al.* (2016) observed that the LP is a powerful tool that can allow the organizations to solve practical economic problems and is widely applied in management of natural resources. The LP model provided a range of feasibility of areas for decision making for optimal solution of constraints on activities implemented by the CFCs including amongst others, the seedling production, plantation establishment, natural forest conservation etcetera.

1.3 Statement of the Problem

The KFS as a public organization is normally engaged every year to prepare AWP&B document as required by the treasury guideline as stipulated in MTB process for funds allocation from exchequer. The AWP&B document presents focus role and a determined direction that estimates organization finances for a fiscal financial year on her operations and forms accountability in carrying out duties, functions and authority. The CFCs who are the beneficiary of the resource are normally given negotiated funds from the exchequer by KFS annually to run their field activities. As the first step towards accessing the funds for the financial year the CFCs are required to develop AWP&B document in line with the amalgamated AWP&B of KFS. However, the ultimate fund allocated to CFCs usually does not normally meet the threshold of their AWP&B implementation. Consequently, CFCs have not been able to implement all planned activities as stipulated in their PCs targets.

1.4 Research Objectives

To address the objectives fully, this research made inferences about population based on data collected from sample of that population.

1.4.1 Main Objective

The main objective of the study was to analyze the impact of AWP&B processes on performance of County Forest Conservancies in Kenya.

1.4.2 Specific Objectives

1. To determine conformity of the amalgamated AWP&B of KFS to requirements by the treasury guidelines as stipulated in the MTB process for funds allocation from exchequer,
2. To evaluate the performance of CFCs against their PCs targets as indicated in their AWP&B,
3. To derive a correlation between funds allocation and performance of CFCs and
4. To formulate AWP&B that will be effective and efficient to negotiate for more funds from exchequer and enable attainment of PCs target by CFCs.

1.4.3 Research Questions

Consistent with the above research objectives, the following research questions were derived:

1. How do the amalgamated AWP&B of KFS conform to requirement by treasury guideline as stipulated in MTB process for funds allocation from exchequer?
2. How do the CFCs perform against their PCs targets as indicated in their AWP&B?

3. What is the correlation between funds allocation and performance of CFCs?
4. How can the AWP&B be made more effective and efficient in order to negotiate for more funds from exchequer and enable attainment of PCs target by CFCs?

1.5 Justification of the Study

The AWP&B is the process by which an organization estimates its finances and set out activities to be implemented within the financial year in line with the organization strategic plan, policy decisions by the board and the blue print of vision 2030 and it forms accountability for organization in carrying out its duties, functions and authority. It is from the Programme Performance Reviews (PPRs) of AWP&B results that forms the basis of economic growth and enables KFS to identify and prioritize the drivers and enablers to be included in budget proposals framework for negotiations of funds in the MTB. Over the last 10 years of the fiscal financial years (2010/2011-2019/2020) the budgetary requirement for the KFS strategic plan was Kshs 91.539 billion to effectively realize the activities implemented by the KFS. Based on the approved budget for the last ten years amount available was only Kshs 55.636 billion leaving a deficit of Kshs 35.903 billion. Thus, the reported funds inflow of the strategic plan had an implementation performance ratio of 61%. Factor that has prevented the full implementation of the KFS strategic plan is less money because of the absence of strong enabling amalgamated AWP&B of KFS to negotiate for more funds from the exchequer. The study intends to resolve the problem by analyzing the impact of AWP&B processes with a view to improving it so that adequate funds can be negotiated and be made available for

consideration for allocation from the exchequer and enable attainment of PCs targets by CFCs.

1.6 Scope of Study

The CFCs in Kenya was set as the study area for analysis of the impact AWP&B processes on performance. With a population of 47 counties in the country, 17 counties were sampled. This area of study was selected for research because the CFCs contribute to implementation of the AWP&B processes in the county in line with the policy directions of the KFS as a semi-autonomous government agency. The AWP&B of CFCs are derived from the amalgamated AWP&B of the KFS. Moreover, CFCs implements signed PCs which are commitments derived from their AWP&B. The prepared AWP&B estimates the CFCs finance requirements and set out activities to be carried out within the financial year in line with the organization strategic plan, policy decisions by the Board and the Blue Print of Vision 2030.

The AWP&B developed help the CFCs prioritize projects and activities, ensuring that the most important initiative receive the necessary resources released and attention. The AWP&B processes implemented by CFCs forms accountability for them in carrying out their duties, functions and authority and in return prepare and provides progress reports for Monthly Report Appraisal (MRA), Quarterly Report Appraisal (QRA) and Annual Report Appraisal (ARA) to KFS for policy and decision making and for any intervention by the management of the organization. Further, the CFCs are the beneficiary of funding

from the exchequer which are allocated to them to be used to implement the AWP&B activities in the county.

1.6.1 Limitations of the study

The 17 Counties were sampled out of a population of 47 and inferential statistics employed in the analysis. The sample size was a limitation in the study since larger sample size would have ensured a good representative distribution of the population. Lack of available and/or reliable data also limited the scope of the analysis of the impact of AWP&P processes on performance of the CFCs becoming a significant obstacle in finding a coherent trend of performance of various CFCs in country. There was also limitation in cultural and other types of bias in providing data on work plan targets and achievement during the financial year under survey. Finally, there was limitation on having access to response for data collection for classified information.

1.6.2 Assumptions of the study.

The study assumed on resource availability that CFCs staffs will be available to implements the PCs targets as indicated in their AWP&B processes, budgeted funds will be disbursed on time and equipment, facilities, and materials will be procured without delays. On operational efficiency that activities for the CFCs will be implemented within the planned timelines, CFCs productivity will align with expected outputs levels, no major disruptions of absenteeism of CFCs will occur. On cost stability that prices of materials needed to implement activities will remain stable. That is inflation and exchange rates will not drastically affect costs and supplies will honor agreed costs and delivery schedules. On external environment that political, economic, and social

conditions will remain favorable, policies, laws, and regulations will not unexpectedly change in ways that disrupts activities implemented by CFCs. On performance measurement that data collection tool will function properly to track performance, indicators and targets set in the AWP&B are realistic and measurable, and CFCs will provide timely and accurate reporting and on risk management that potential risks encountered by CFCs (financial, operational, environmental) are manageable and contingency measures included in the costing of activities will be adequate if problem arise.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter outlines the relevant review of the literatures related to the impact of AWP&B processes on performance of organizations in public sectors. Section 2.2 of the chapter looks at the review of related literature in public budgeting to establish what exists, the relationship between them and what degree the existing theories have been investigated. Further, the section reviews a number of public budgeting implementation studies that have been undertaken in both developed and developing countries. Section 2.3 of the chapter looks at the theoretical literature review of the verifiable observation of AWP&B processes- that have been undertaken in a similar area of study. The sub-section 2.3.1 reviews literature on the conformity of the AWP&B of KFS to requirement by the treasury guideline as stipulated in MTB process for funds allocation from exchequer, sub-section 2.3.2 of the chapter reviews the literature on the performance of CFCs against their PCs targets as indicated in their AWP&B, 2.3.3 reviews literature on the correlation between funds allocation and performance of selected CFCs and 2.3.4 of the chapter looks at the literature of formulation of AWP&B structure that will be effective and efficient to negotiate for more funds from exchequer and enable attainment of performance contract targets by CFCs. Finally, section 2.4 of the chapter looks at literature review of the knowledge gap.

2.2 Review of Related Literature

Public budgeting is crucial tool for economic policy. According to Menifield (2010) in comparative public budgeting in a global perspective studies, public budgeting plays a vital role in the global economy by influencing resource allocation, promoting macroeconomic stability and fostering economic growth. Public budgeting is a financial plan that estimates the expenditures and revenues of state for the next fiscal financial year. This process reflects the economic and social policies in the country. In the government sector, public budgeting involves financial planning, usually for a period of one-year termed AWP&B, aimed at achieving the economic and social objectives, Baird (2007). Baird (2007) defines budgeting as a quantitative look of a plan of action that assists in the coordination and implementation of development programs.

Sahin (2018) defined public budgeting as a redolent of a technical, quantitative text that refers to expenditures and revenue collection decisions made in a given time frame at central or local levels of government. The budget reflects the public preference and priorities of those members of society who will be served by and included in funding of planned activities. In this regard Sahin (2018) noted that given the competitive demands existing despite constrained resources, the budgetary process, namely the allocation of resources, may basically be expressed as a political undertaking that is shaped by the needs and preferences of the electorate as perceived by the politicians.

Rogulenko *et al.* (2016) presented study findings that the goal of the development and implementation of a budgeting system is to create an instrument for the efficient organization of the activity management of an institution and its structural units by planning, controlling incomes and expenses, and analyzing economic and financial indicators.

Budgeting creates a spending plan for funds and can help ensure there is always enough fund to be released from the exchequer to run the work plan activities of the programmes of the public sector. Budget items are used to plan future financial transactions, i.e., the budget is created before completing expected actions. It also determines a budget role as a base for control and efficiency assessment of company's financial activities. The public budgeting also lies in its ability to act as a compliance and accountability tool.

Rubin (2005) argues that, although the ultimate goal of public budgeting is to provide services and goods to the citizens, it also acts as a powerful tool for holding the government accountable to its people. The government spending plan should reflect the peoples' choices and priorities. Thus, through public budgeting, the citizens should be able to check whether the government's spending plans complies with their choices and priorities. Budgeting assists a government in determining its objectives, strategies, and policy priorities; and to set out the various programmes and activities to be conducted, as well as the anticipated results that would contribute to achieving its objectives and

allocate its limited resources which may include financial, human and asset across competing needs in line with the strategies set and expected performance.

The process of public budgeting has undergone a rigorous transformation depending on the degree of evolution achieved by the individual, society, politics and economy of a country (Sahin 2018). The main types of public budgeting system include line-item budgeting, work plan budgeting, and zero-based budgeting. These three types of public budgeting system have a different emphasis. Traditionally, line-item budgeting has been the predominant method of presenting Government budgets released from exchequer. Some budget reformers have criticized line-item budgeting for holding accountable public organizations for only for what they spend and not for what has been achieved from the expenditure and therefore recommended the adoption of work plan budgeting. The following discussions look at the two-budgeting system; line-item budgeting and work planning and budget. The zero-based budgeting is excluded from the following discussion due to the fact that the purpose of this study is strictly to analyze the AWP&B on performance of public sector.

Line Item Budgeting (LIB) is a list of all planned cash expenses and revenues (Aliabadi *et al.,* 2019). It is partly as a documentation of how public funds are to be spent. Therefore, a LIB is a financial document that lists how much will be spent on every item included in the budget. According to Baird (2007) LIB is a simple and broadly used budgeting system that is primarily concerned with the control of aggregate government

spending limits. However, LIB system does not inform how well the fund was spent and what results have been achieved from this spending.

The use of LIB in the public sector is often associated with several benefits. These benefits include; achieving financial control in terms of expenditure and revenues through the implementation of a systematic legal procession spending and collecting revenues; maintaining traditional financing processes helps government units to obtain the needed funds much easier if compared to other budgeting systems. LIB also helps to control the limits of government aggregate spending; is less complex to be prepared, and much easier to be used, thus making it easy to apply and ensure uniformity across different entities; and it is a control-oriented and thus makes it an effective and practical policy implementation tool (Baird, 2007).

Despite its advantages, the application of LIB system is not without its weaknesses. Some of its shortcomings include; focusing solely on controlling the documentation aspect of fund disbursement rather than the output or the result of the expenses; the information provided by LIB is not sufficient for the purpose of planning and decision making; it focuses on inputs while ignoring outputs and the relationship between them, thus making it impossible to identify the efficient use of economic resources; is unable to monitor and evaluate the performance of specific governmental programmes and activities in view of the distribution of resources devoted to those programmes; the basis for preparing LIB estimates and appropriations is in accordance with the concept of assessing the value of

expenses regardless of output, which fails to provide users with accomplishment measures that connect programmes to goals achieved; the basis of LIB estimates is usually unclear and cannot be used as a control tool to reflect the accomplishment of programmes. LIB also does not take into consideration the relationship between programmes which seek to achieve a particular goal, leading to difficulty in the coordination between the programmes themselves; and the estimates covered by the budget appropriations is a means to encourage spending regardless of the need to spend, since the appropriation for the next year depends on the actual spending of this year (Baird, 2007). As noted by Baird (2007), LIB is simple and is broadly used in many countries, but with this method of budgeting one cannot know how well the money is being spent and which Fiscal Financial Years (FFYs) targets have been achieved.

Under AWP&B, resources are allocated on the basis of goals, objectives, and strategies. These performance expectations, in turn, are translated into measures of effectiveness and efficiency. Work results which are actually performance are then evaluated on the basis of this planned performance. AWP&B system emphasizes on performance, output and outcome and assists in planning by emphasizing on the goals and objectives achievement as well as focusing on the implications of budgeting decisions. The AWP&B helps managers make decisions by evaluating the difference in cost implications of alternatives and presenting information that facilitates decision making based on the best outcomes given the fund from exchequer for utilization.

Aliabadi *et al*. (2019) observed that AWP&B aims at improving the efficiency and effectiveness of public spending by connecting the funding of public sector organizations to the results they achieve, by making use of systematic performance information. The Aliabadi *et al.* (2019) noted that AWP&B also requires that budgeting to be structured based on activities rather than spending regardless of the outcome to enable attainment of performance contract targets of the public sector.

The use of AWP&B in the public sector is often associated with several benefits. These benefits include: It helps in determining the priority of the projects to be implemented; helps in planning and managing the delivery of services in the future; monitors the allocation of resources to a project and determines how they are used to meet the goals of the organization; helps in spotting the areas where higher funds are required; helps in identifying areas where costs reduction can be implemented and savings can be made; adds accountability to the organization, since each project has its respective budget, performance measurement can be done and firm accountability can be set; helps in rationalizing budget allocations by using performance information as a basis of evidence; enhance to improve the understanding of crosscutting programmes in government; helps agencies connect their daily activities to overall government outcomes and similar activities of other agencies and provide cost effectiveness comparison between programmes. AWP&B also helps in aligning government spending with its goals and provides information for decision makers to help them in making strategic decisions.

Despite its advantages, the application of AWP&B system is not without its weaknesses. Some of its shortcomings include: If the AWP&B is incorrect, it can lead to increase in costs; it requires a lot of information and can take a lot of time to find out exact financial resources required. Additionally, during the year, when any changes must be made to the resources required, it becomes very difficult to achieve a balanced budget; it is biased towards short term planning; Sometimes, overlapping causes several changes to the budget. For example, the forest conservation and management programme may include the electricity repair expenses in the budget, which may or may not occur. This leads to the budgeting of dual expenses. The AWP&B sometimes makes it difficult to evaluate the performance of the project. Multiple layers of administrators govern a project, so finding out the administrator can become a daunting task.

Although the AWP&B processes could not rationalize and change the political budgeting process, it surely adds value to discussions, as performance information is considered when the level of funding is decided by the treasury of the central government (GOK, 2024). With suitable information, politicians are able to call for improvements and better understand the issues involved. AWP&B and its performance information may play an active role in resource allocation and gives good reason for reallocation of resources given performance review information; changes the focus of discussion from line items to broader objectives and performance of agencies and programmes; impacts decisions about proposed new programmes and on funding increases or decreases to programmes

and provides benchmarks which are useful to legislators in decision making in the approval of the national budget.

According to GOK (2024), the budget is presented by vote and programme in line with Section 38 (3) of the Public Finance Management Act, 2012. The Small Working Groups (SWGs) who sit to negotiate in the MTB are therefore required to review AWP&B and align them to the mandates of the respective MDAs in order to qualify for requested fund allocation from exchequer.

2.2.1 Public Budgeting in Developed Countries

A Public budgeting is said to be a deficit budget if the estimated public expenditure exceeds the expected public revenue in a particular financial year. Most of the budget studies in developed countries were carried out in the United States and focused on public budgeting.

Melkers and Willoughby (2001) found that state budget officials perceived that AWP&B initiatives have not been so successful in changing at suitable levels as in the case of management improvement in state agencies. However, Willoughby and Melkers (2001) investigated the perceptions of implementing AWP&B. A survey was distributed to executive and legislative budgeters regarding the AWP&B established in their states. The results showed that there were differing perceptions across the branches of government, regarding both the extent of AWP&B implementation as well as its success. The result

also showed that states with a better understanding of AWP&B have not necessarily realized greater success in terms of effectiveness from this budget reform, compared to states with lower understanding of AWP&B.

Melkers and Willoughby (2001) set up an objective to examine the possibility of implementing AWP&B in the 50 states in the United States of America. They undertook survey among the legislatives in the United States to assess their perception of AWP&B. They surveyed a random sample of law-making and executive budgeters from fifty states, asking them for their impressions of AWP&B implementation in their states. Findings indicated that the implementation of AWP&B was proceeding slowly and that there were some benefits of bringing to light performance results as well as some implementation problems. The study also revealed that budget officers were satisfied with the role of performance information in the budgeting process.

2.2.2 Public Budgeting in Developing Countries

The main goals or objectives of public budgeting in developing countries are those of economic policy as a whole which include economic growth, internal and external stability, and the attainment of an appropriate distribution of income and wealth. Prior research on budgeting has been conducted over the years focusing on public budgeting in development countries: AWP&B processes is about making budgets more transparent, ensuring that public money is spent on the right priorities, and linking budgets more closely to the purpose of spending. AWP&B organizes the presentation of the budget

around the objectives of public activity, such as improved health, and then tries to measure progress towards these objectives using a set of key performance indicators and targets.

Mustafa (2000) investigated the effects of the budgeting decision-making process on the application of AWP&B in Jordan. He studied the link between the method of theory and pattern of decision-making for budgeting and the problems associated with the budget and their influence on financial management. He also attempted to evaluate the approaches taken by decision makers to apply AWP&B. His study found that the AWP&B provided justification for new work expenditure in terms of service performance control.

Shawabkah (2000) investigated the appropriateness of the accounting system of government for the implementation of AWP&B. in Jordan. He studied the development of budgeting preparation in the Jordanian public sector, aiming to identify the most important bases available in Jordanian accounting systems appropriate for applying AWP&B. The author provided suggestions and recommendations on developing government accounting systems with appropriate applications of AWP&B. He found that the current government accounting system in Jordan did not require AWP&B.

Alrabadi (2001) reviewed the application of the AWP&B on performance in the Jordanian government's budget system. The objective of the study was to explore the

expected results of applying the method of AWP&B on administrative aspects such as rationalizing decision-making, improving administration control, and performance rationalizing expenditure in the public sector.

Alloamari (2002) examined the difficulties in the preparation and implementation of AWP&B on performance in Jordan. The study showed that there were a number of difficulties facing the preparation of the AWP&B such as a lack of government administration, lack of information efficiency, cost accounting system, the control of activities and work, duplication of work, lack of human capital, lack of measurement of performance, and lack of coordination between ministries. The researcher recommended the need to develop the current cost accounting system, establish a standard cost basis for measurement, reduce the duplication of work in Ministries, Departments and Agencies and reduce the duplication between control systems through effective coordination between them, and provide accounting professional competencies in the government sectors.

Tayib and Hussin (2003) conducted a study on Malaysian universities to identify and explain the present practice of Malaysian public universities budgeting systems, and to provide some recommendations to Malaysian public universities for improving their budgeting systems. A total of 237 questionnaires were distributed to eight public universities, 98 were completed and returned, making up a response rate of 41 percent. The findings indicated that Malaysian public universities, to some extent, adopted good

budgeting characteristics. This indicated that the budgeting systems of the public universities were acceptable and can be used as a control mechanism to strengthen performance measurement systems.

Dixon (2005) analyzed Thailand's attempts to reform its budget process. He was involved in the early stages of the second round of Thai budget reforms and utilized his own experience as well as reports of subsequent World Bank as references for the study. However, he indicated that other parallel research validated his findings. The findings from his study indicated that a centralized budget system is incompatible with AWP&B. Moreover, the study highlighted that reform requires political will and is not merely a managerial problem.

Farid (2010) conducted a study on Palestine universities. The researcher examined the willingness to adopt AWP&B in the universities and discovered that some factors affect AWP&B. The factors are management support, attitude toward change support, and training. He used 200 questionnaires to collect the data. He found that there was a positive relationship between management support, attitude toward change support and training and the willingness to adopt AWP&B.

KDI (2020) studies found that the government of Uganda began transitioning from output-based budgeting to AWP&B in 2013 in a bid to improve the link between budgeting and national strategic objectives. Output-based budgets were developed to

reflect the relationship between funding and expected outputs. The drawbacks of Uganda's output-based budgeting system included unclear alignment with national development plans, insecure and tedious manual processes, inadequate data access and security controls, and incompatibility with other government budgeting systems. However, replacing output-based budgeting with AWP&B posed challenges related to human resources, organizational capacity, basic infrastructure such as reliable roads and electricity, and interagency coordination.

Abdul and Politeknik (2015) in their studies stated that accountability remains a central issue in the field of public sector in Indonesia. As a developing country, the issue of good governance is still a major concern in relation to the use of authority and public sector management. Many developing countries proved that the culture of corruption has been so entrenched in government bureaucracy that is precisely characterized by the scarcity of resources. In that context, the absence of accountability is very prominent and becomes the dominant character of administrative culture during a certain period.

Lakin *et al*. (2018) in their studies to review AWP&B practices in developing countries observed that the AWP&B in these low- and middle-income countries is about making budgets more transparent, ensuring that public money is spent on the right priorities, and linking budgets more closely to the purposes of spending. Program structure in AWP&B is central to some of the most fundamental questions in public finance reform. As countries introduce AWP&B or reform their existing systems, it is useful to examine

global practices to shed light on how governments define work plan objectives as part of their broader quest to shift budgeting toward results that matter to citizens.

2.2.3 Public Budgeting in Kenya

In Kenyan, a well-defined AWP&B is aligned with the organization's overall strategic objectives, ensuring that all activities contribute to the achievement of the larger goals of the organization (KFS, 2023). The budget for processes provides a framework for cost control, identifying potential areas for savings and ensuring that expenses are aligned with the approved budget (GOK, 2024). Execution period or the budgetary years in Kenya keep running from 1st July to 30st June termed FFYs. According to GOK, 2024, amid this period a set down MTB use structure spending cycle followed in the arrangement and execution of national spending plan. The MDAs review expenditure to examine the clerical past consumption against the public service's needs as laid out in the Kenya's Vision 2030. The MTB sets the seat marks for the ensuing spending year and the other two forward years' exercises and the assets required to effectively and efficiently undertaking the arranged exercises.

The final products of MTB highlight the lessons learnt, practice experience, difficulties and how to relieve them in the usage of the yearly spending plan (GOK, 2024). The survey keeps all the line services consumptions and exercises in line as they should be adjusted to a managing strategy archive and the monetary allowance in this manner discovering the respectability of execution.

The SWGs get ready and submit introductory division reports to the treasury for thought as stipulated in the guideline. Treasury then assembles division hearings for the harmonization of segment consumption projections and exhortation in transit forward for the planning of definite reports on the Medium-Term Expenditure Framework (MTEF) gauges. The line services then conclude on the clerical organized and AWP&B spending plans in accordance with the rules emerging from the SWGs and orders of the full-scale working gathering (GOK, 2024). This program construct spending plan in light of the rules as set by particular round from the treasury and other managing strategy archives i.e., the Kenya vision 2030 or the MTB. Software engineers highlighted in these archives are organized in the financing and clear timetables given to achieve the program. The national AWP&B was first introduced in Kenya in 2013 as a requirement by the Treasury guideline as stipulated in MTB process for fund allocation from exchequer. However, it had actually limited public and parliamentary access to key budget information substantially, due to poor design (Lakin and Magero, 2015). Further, 2014/15 FY rectified a number of the flaws in the government's initial attempt to shift to AWP&B and there were some additional modest improvements in 2015/16. According to the Lakin and Magero, (2015) the National Treasury of Kenya presented its annual budget in a work plan format for the third time in April 2015. This was in line with international best practice and the requirements of Kenya's own Public Finance Management Act 2012, which also initially required all of Kenya's counties to shift to AWP&B in the 2014/15 financial year.

2.3 Theoretical Review

2.3.1 Conformity of the AWP&B to requirement by the treasury guideline as stipulated in MTB process for funds allocation from exchequer

The generally accepted reasons for reforming national planning and budgeting processes are numerous and include the facilitation of better service provision, more effective and efficient use of resources, more targeted use of funds, and greater accountability for policy implementation.

Sankei *et al.* (2020) observed that alignment of variables to corporate strategy significantly enhance performance of the organization. However, many governments face significant challenges trying to improve planning, budgeting, and the links between the two process areas in their attempt to align applicable variables towards enhancement of work performance. This in essence has really affected the general performance of different organizations.

According to Ugbogbo and Abioluwajumi (2019) AWP&B processes in any given country of the world is to make life abundant and tolerance through the provision of necessary infrastructure and economic development initiative. However, Ugbogbo and Abioluwajumi (2019) observed in the study of reformed AWP&B processes in the Nigeria Public Sector that the country was still at state of despair as far infrastructural development was concerned. This in effect called for evaluation of the impacts for reforming the structure of the AWP&B processes vis-à-vis policy legislative reforms.

Global Fund (2021) applies budgetary framework where core funding model uses a modular approach and costing dimension that enhances matrix reporting and the linkage between AWP&B processes information. The interventions and activities are defined in the modular approach and the cost groupings and cost inputs in the costing dimension. According to the Global Fund (2021), this negotiation budgetary framework approach provides applicants and implementers with a standardized costing dimension that allows for fund allocation, the setting of realistic goals for each defined period of the grant life cycle, strengthened tracking of budget versus expenditure data and the alignment of partners and country data systems as guided by the stipulated requirements of the treasury of the central government.

UNDG (2014) applies MTB framework which defines FFY arrangement that allow government to extend the horizon for fiscal policy making beyond annual budgetary calendar. The UNDG (2014) budgetary framework strategy has six levels of approach that includes; defining realistic funding gap, agree on strategic approach to financing, analyze external environment sources to unfunded outcomes, prioritize potential partners and finally develop the joint resource mobilization strategy.

Currently the MTB of the FFYs is being prepared for fund negotiation against a background of a contracting global economy occasioned by pandemic (World Bank, 2021). The world economy is experiencing an exceptionally, strong but highly uneven

recovery. However, according to the World Bank (2021) on the global economic prospects, the global growth picked up to 5.6 percent in 2021 reflecting strengthening of activity and policy support measures in large economies. Policy makers can help entrench a lasting recovery by undertaking growth enhancing reforms and steering their economies onto a green resilient and inclusive development path. As highlighted by World Bank (2021) global economic prospects report the uneven recovery which underscores the need for a forceful policy effort to address multiple near-and long-term challenges. This policy response requires speedy action from government, the private sector and the international community. Forest cover just 30% of the global land area, yet they provide habitat for the vast majority of the terrestrial plant and animal species known to science (FAO & UN, 2022). However, FAO and UN (2022) highlight those solutions that balance conservation use of forest biodiversity are critical and possible.

According to Hans (2015), plans involving negotiations with multi-level approach in an attempt to solve financial budgets at the national levels. Situations of competition and cooperation between several involved parties use mathematical figures to justify their position for consideration to the financial needs to implement their activities (Hans, 2015). Typically, the challenges arise from the need to establish clear policies, ensure that budgets reflect those policies and that spending is in line with allocations and the need to measure results and feed those back into policy making.

In public sector organizations, it is clear that control of resources is key in budgetary management and planning. Treasury guidelines that are lengthy and bureaucratic should be evaded or modified to allow staffs that have first-hand information of situations to make decisions locally in their work station. Scott (2001) suggested that it should involve transferring responsibility and control resources to a local level. This would naturally indicate less need for central finance staff to be involved in the detail of planning and controlling budgets.

Other research studies in public sector organizations however suggested that some sectors of foremost expenditure, such as central overheads and staffing, generally to remain under central control (Keen, 2024). The workforce in the public sector is subject matter to nationwide agreed terms and some decisions related to staffing may encompass political implications. Therefore, the element of central control must be maintained regardless of the apparent clash with the notions of devolved AWP&B system development. Paradoxically, the need to ensure that the strategic aims of the organization are met has meant that in reality tighter control exists over how money can be spent, with restrictions over, for example, choice of supplier and authorization procedures restricting the scope for autonomous decisions (Keen, 2024).

Sankei et al (2020), there is much evidence that, structurally, public sector organizations have moved towards decentralized operational management but with concomitant highly centralized strategic control measures. This implies that the ultimate responsibility for

work planning and budgeting system remains centralized since such matters cannot be delegated. When budgets are devolved, the senior management loses some direct influence over the decision-making process (Scott, 2001) and there is a risk that such a managerial structure "potentially weakens the "*centre*" or the senior executive's position and ability to drive change (Cranfield & Taylor, 2008). It is argued that the restrictions on financial resources and budgets for growth are seen as militating against devolved systems and the principles appear to be weakened with a tendency on the part of senior management to "claw back" resources when unexpected changes occur (Scott, 2001). The purpose of the bold action is to regain a lost advantage of a strategy laboriously and gradually in response to poor performance in the organization. Nevertheless, an apparent advantage to the institution is in the effectiveness of cost control whereby the senior management has an upper hand in controlling costs in their responsibility.

This benefit is negated in organizations where there exist multiple sources of access to budgets and managers decisions effect commitment of another people's budget as noted by Chenxi (2001). Normally, financial responsibilities are aligned with management such that the persons in charge of planning and budgeting are accountable for the financial repercussion of their management decisions.

2.3.2 The performance of CFCs against their PCs targets as indicated in their AWP&B

Corporate managers have the responsibility to deliver and be able to achieve their PCs targets as indicated in their AWP&B with the provided scarce budget resource and their performance evaluated. They are to consider risk mitigations by putting in place contingency planning within the budget that would help mitigate potential risks that could impact the organization's overall performance (KFS, 2023).

Okpara and Idowu (2013) on corporate social responsibility emphasized that corporate managers of today are too aware that they will not be judged by their stakeholders only on the basis of their financial performance. Since the economic responsibility of a business is to produce goods and services that the society desires and sell them at a profit, the corporate managers have sole responsibility to identify its stakeholders and incorporate their needs and values within the day-to-day decision-making process (Okpara & Idowu, 2013). As observed by Savingnon *et al.* (2019) the AWP&B processes would offer the organization the opportunity to promote consistency and reconciliation between budget allocation in the plan and policy priorities. Thus, the system integrates strategic management and performance budgeting and the process of implementation and makes the purposes of spending clearer and accountable for effective and efficient use of public resources. However, although a budget setting should be informed and influenced by the strategic plan priorities of the organization as further observed by Savingnon *et al.* (2019) this is not always done adequately and the budgeting setting is often effectively

disconnected from the fiscal financial year of the strategic plan that results to under performance of organization.

The public organization that desires to transform their AWP&B processes need to consider their actor's perceptions regarding the planning and budgeting process (Aliabadi *et al.,* 2019). By explicitly considering their perceptions the organization may be able to solve any loose coupling as a result of bad performance. According to Aliabadi *et al*. (2019) findings a loose coupling between perceived and regulated AWP&B processes leads to budgetary slack as a barrier for authentic information flow to achieve the intended planned activities in the organization. AWP&B processes have been considered as an enabler to assist the corporate managers implement and perform responsibly for positive achievements. However budgeting processes are often simultaneously used for the conflicting purposes of planning and performance evaluation. While economic theory suggests that organizations should use separate budgets for conflicting purposes this contrasts with existing evidence that organizations rarely do so.

According to Markus and Robert (2015) observation when budgets are used for planning and performance evaluation, it increases the subordinate's budget proposals during the negotiation and performance after the negotiation. These effects tend to be even larger when the superior is restricted to a single budget rather than separate budgets for planning and performance evaluation, particularly with respect to subordinate performance (Markus & Robert, 2015). Markus and Robert (2015) further observed that planning task

that conflicts with the performance evaluation task affects behavior in budget negotiations and their outcomes. The two tasks are in conflict because there is need to provide subordinates with sufficient financial incentives counters and the need for accurate planning and, thus, the two budgets should be set to different levels. Thus, performance evaluation management is one of the major features of the reforms introduced together with decentralization budget and provides a means of measuring the performance of a manager (Seafoss & Monczka, 2006). It signifies those decisions made by a manager will be taken with due consideration to their budgetary impact, the goal being to keep expenditure within the budgeted sum. The elements discussed above are uncontrollable and thus makes performance measure unreasonable.

Goddard and Albert (2007) suggested that financial measures are seen as inadequate measures for long-term strategic performance reflecting perhaps the restrictions placed on many middle managers who lack empowerment to make decisions despite being responsible and accountable for a range of targets and performance indicators.

Performance evaluation management aims at attaining operational effectiveness which in a broader sense refers to a number of practices that allow an organization to better utilize its resources as observed by Koril *et al.* (2015). Involvement of work plans and budget system setting procedures for performance forms bases of PC targets and is considered as a way of solving a number of challenges.

Reid (2002) suggests that participation in the AWP&B processes helps staff to see its relevance to them. However, Reid (2002) questions the extent to which junior staffs in primary hierarchical organizations with existing inequitable power relationships have the ability to influence the setting of planning and budget targets. The disadvantage of this approach is that easily achievable targets and undue caution can be set and in essence will not realize the expectation of the organization to deliver its strategic plan goal and objectives. The most important use of AWP&B processes variances is that they assist managers to learn from their precedent slip-ups in order to improve their future performance in the supplementary budget provisions.

2.3.3 Correlation between funds allocation and performance of CFCs

Preparation of AWP&B document is necessary prior to any interaction with the treasury to negotiate for fund to implement the activities. One of the key tools used for planning and controlling is the budget. It is a key as a management tool for planning, monitoring, and controlling the finances of an organization centered on the efficient allocation of scarce organizational resources to help achieve strategic goals and objectives. Thus, budgeting is regarded as one of organization's most important coordination and control mechanisms for resource management (Markus & Robert, 2015).

Markus and Robert (2015) described budgeting functions as: operational planning and coordination, motivation and performance evaluation, and goal communication and strategy formulation. Thus, Markus and Robert (2015) observed that budgeting functions

encompass both decision-making and control-oriented purposes of management accounting information. As these purposes often conflict, budget-setting can present firms with major challenges in the process of implementation. However, according to Veronica and Mihaela (2012) the concept of controlling budget-setting should not be misaddressed with the concept of control of budget-setting to enhance the performance. The Veronica and Mihaela (2012) observed in their findings that controlling budget-setting represents a functional management system, having the part of coordinating the planning and informing into the direction of achieving the results aimed. The control aspect had the purpose of consolidating the coherence and the consequence within an organization. The control had been also a process of transversal organization for the company's activities. In the long run, the control signifies a process of permanent learning, through accumulation and experience exchange. The system of yearly planning and drawing of budget, as part of an effective and efficient system of controlling, is based upon the information provided by the management accountancy. This has influenced the behavior of people by the nature and the way information is transmitted, has directed the strategic decisions and has influenced the enterprise's structure and the system of performance evaluation. This type of accountancy has been especially directed towards the future performance of the employees (Veronica & Mihaela, 2012).

According to Henttu-Aho (2018) it is important to use rolling forecasting and link it to other practices in resource management control system. Henttu-Aho (2018) observed that in a proactive planning, rolling forecasting promote information oriented towards more

realistic forecasts and ideas emerging from interactive discussions planned targets. In the other hand on reactive type planning, he observed that rolling forecasting supported the supremacy of annual budgeting and thus the synergies of the proactive and reactive practices inform managers of the outcome levels that is likely to be achievable and realistic basis for setting the targets of the prioritized activities to be implemented.

The concept of a model is a simplified representation of a real or theoretical system at some particular point in time or space intended to provide understanding of the system. Use of Budget as a planning and control tool for resource management to be realized require development of models that represents that communicating set of concepts of the practice. System models are specifically developed to support analysis, specification, design, verification, and validation of a system, as well as to communicate certain information (Jorgensen, 2018). Model fitting is important to describe trends in data set and to quantify relationships between dependent and independent variables.

According to Jorgensen (2018), models are increasingly used in resource management because they are the only tool that is able to relate quantitatively the impact on an ecosystem with the consequences for the state performance. Therefore, AWP&B model also focuses in the same manner only on the objects of interest for the considered problem is different.

2.3.4 Formulated AWP&B that will be effective and efficient to negotiate for more funds from exchequer and enable attainment of PCs target by CFCs.

AWP&B framework shows the government overall strategy for the budget and provides the link between the government's overall policies and the annual budgets measured through organization's work performance.

According to GOM (2014), the work performance information is used to make decisions on policy interventions and resource allocation. Such information is produced with the help of performance indicators specifying means by which achievable of organization's objective or outcomes and outputs can be judged. Thus, the system and its elements in the structure is an internally organized whole where elements are so intimately connected that they operate as one in relation to external conditions and other systems. However, the challenge is to specify indicators that measure things that are useful from a management and accountability perspective (GOM, 2014). This means managers need to be selective when defining suitable key performance indicators and specify performance measure in relation to inputs; activities; outputs; outcomes; and impacts.

AWP&B processes is a specialized tool which serves as an enabler to create a budget structure and effective financing management to execute programme activities in any company. Newind (2018) observed that the system application allows presenting data on budget implementation based on data generated from the financial and accounting system according to the scheme applied by a particular entity and at the defined level of data

aggregation destined for segregation. Moreover, this tool allows creating a budget structure through defining budget cells and type-cost items, as well as budget plan for a defined period (Newind, 2018). Thus, main features of the system relate to the creation of the budget structure and budgeting process servicing. The application foresees the creation of full and partial budget plans in various planning perspectives together with the service of process consisting in the implementation of changes.

Newind (2018) further observed that planned budgets and their implementation can be viewed in accordance with their defined parameters as well as track changes in particular versions and variants. This system structure application also allows generating a printout or saving a particular budget to a file. Thus, AWP&B processes is in effect as observed by Newind (2018) is an integration of a number of techniques process for identifying, costing and signing a complexity of resources for establishing priorities and strategies in a major program constituting a number of various activities that require forecasting costs and expenditure. However, there are challenges and opportunities in AWP&B processes framework strategies reforms that would provide enabling environment for fund negotiations by the organizations. The negotiations are vulnerable, unless they are protected by procedural framework strategies that are to be followed by the parties involved (GOK, 2024). According to GOK, 2024 medium term budget of the financial year are normally prepared against a background of a contracting global economy occasioned by unforeseen circumstances. As a result, policy frameworks strategy in place

for fund negotiation often seems to fall short of providing satisfying solutions to a growing number of problems.

Despite these challenges experienced using a framework strategy to negotiate fund by parties there are opportunities which can be implored to support medium term budget negotiation of funds from exchequer for planned activities. According to GOK (2024) one remedy opportunity for building up the resource envelope to resolve the issue of fund allocation deficit, is by controlling expenditure by the programmes. In the process the adding more taxes to consumers to raise more fund will be avoided.

To reinforce the MTB policy framework used in the negotiation of fund, the Government has initiated opportunity interventions of putting in place several fiscal policy measures in the FFYs to address the adverse effects of pandemic that might have negative impact on the fund negotiation in the MTB (GOK 2024). The framework strategy according to GOK (2024) support MTB negotiation of funds anchored on the Medium-Term Plan (MTP) of the Vision 2030 with a special focus on the Government ‘‘Agenda’’. The deliberate effort to focus on the Government ‘‘Agenda’’ is an opportunity to negotiation framework to set stage for a resilient and sustainable economy which will continue to safeguard the reconciliations of resource allocation in the MTB and enable attainment of performance contract targets by the public sector.

2.4 Conceptual framework

The figure 2.1 below is conceptual framework showing independent, intervening and dependent variables.

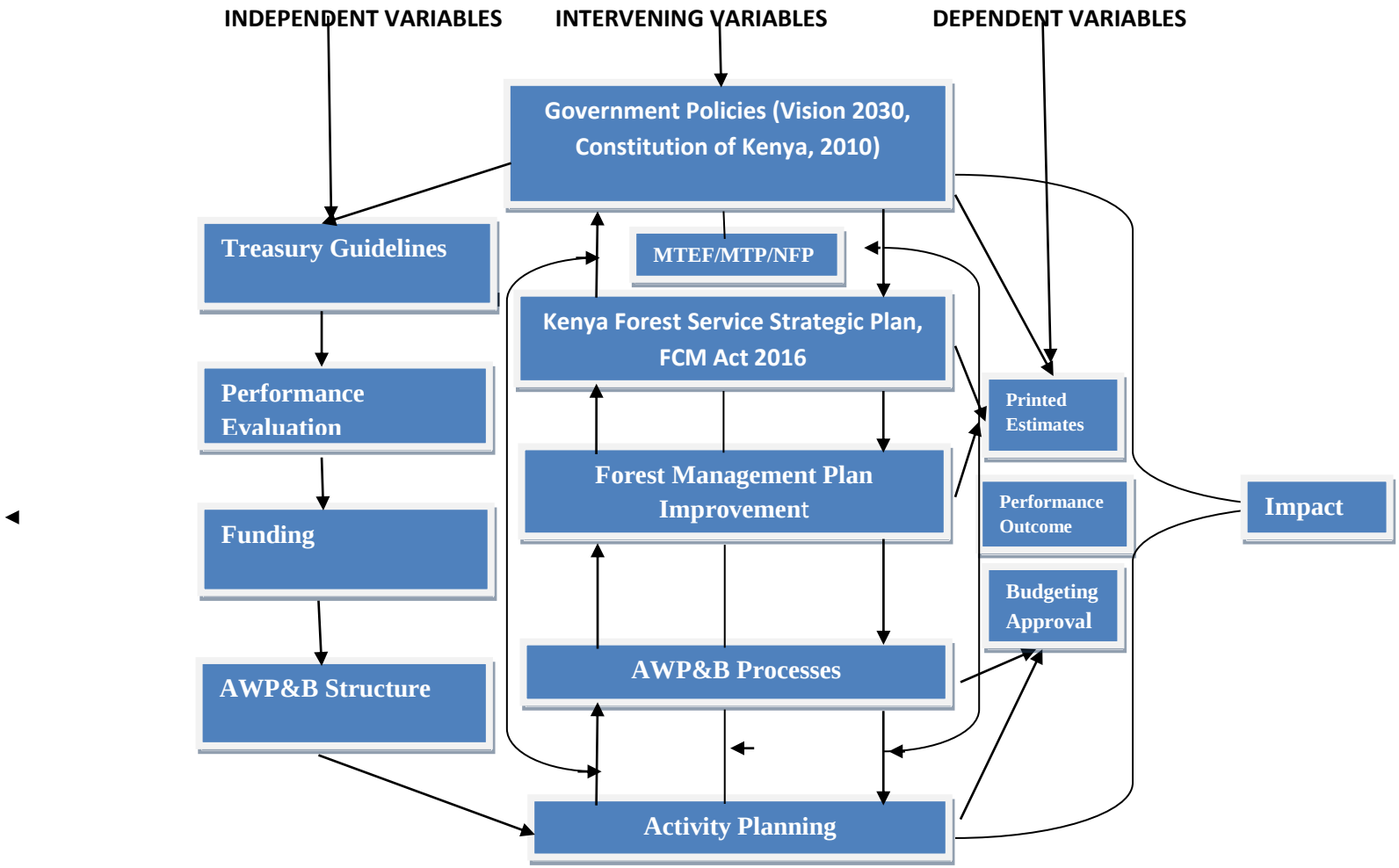

Figure 1.1: Conceptual framework (*Source: Author, 2025*)

The underlying conceptual framework theory label in the figure 1.1 illustrates the drivers of the impact of planning and budgeting processes on performance of CFCs against their PCs targets as indicated in their AWP&B. This conceptual framework theory was propounded by the study as one of the alternative research approaches to reform on the system for understanding of how the research problem will be explored, the specific direction the research will have to take, and the relationship between the different variables in the study. As observed by Adom *et al.* (2018), the conceptual framework provides ingredient of quality research work that shows the student map of the research she/he seeks to undertake, a model illustrating variables that specify the problem and gives direction to the study.

2.5 Knowledge Gap

An AWP&B is meant to link resources with activities and performance targets. However, in practice there are several knowledge gaps that weaken the connection between the plan, the budget and actual performance. Planning and performance linkage gap on AWP&B often list activities and allocate funds, but do not clearly link them to measurable performance indicators (outputs/outcomes). Many plans stop at what will be done rather than what will be achieved.

Another gap is on the budget performance. Budgets may be input-based (logistic, operations) rather than result-based. There is also lack of clarity on how resources allocations directly contribute to achieving specific performance targets. However, it is noted that control systems are also important in order to notify and guide management in

allocating the necessary resources to enhance the performance of CFCs. This will facilitate clear communication and transparency with stakeholders ensuring that everyone understands the organization's goals, timelines and resource requirements.

Monitoring and Evaluation also play a key role in the AWP&B and therefore considered as gap in the study. Regular tracking of progress against predefined Key Performance Indicators is essential. Without effective monitoring, organizations may struggle to identify areas for improvement. This absence of sufficient evaluation and control system add to the diminishing focus and emphasis of the importance of AWP&B processes implementation. Without monitoring and control measures, AWP&B processes implementation cannot be tracked.

The analysis of the impact of AWP&B processes on performance of CFCs, many studies have been conducted on the concept of work planning and public budgeting but few or none have focused on a particular area on delivery of performance satisfaction. The knowledge gaps enlisted is an opportunity to explore on this topic of AWP&B on performance in more depth. The literature review that provides reference to a number of research studies which identified AWP&B processes, few or none has focused on the current budgeting process. By addressing these knowledge gaps and implementing best practices, organization can improve AWP&B processes, ultimately enhancing performance of the CFCs who play a key role in implementing planned activities.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter looks at research design, study area, target population, sample and sampling procedure. It gives a brief description of the instruments used in data collection as well as its validity and reliability. The chapter gives an insight of primary and secondary data collection procedure, data analysis and presentation and also provides ethical issues and consideration in the study.

3.2 Research Design

According to Kothari 2014, the research design constitutes the blue print for the collection, measurement and analysis of data. As such the design in this study included an outline of what the researcher did in regard to research main objective to answer research questions derived from research specific objectives, its operational implications, to the final analysis of data. This study used both descriptive and inferential statistical research design involving drawing conclusions about population based on data collected from sample of that population. The information concerning the impact of AWP&B processes described ‘‘what exists’’ to independent, intervening and dependent variables condition.

The study determined conformity of the amalgamated AWP&B of KFS to requirement by the treasury guidelines as stipulated in MTB process for funds allocation from exchequer.

This was done by examining secondary data of documentations and treasury guidelines in place to determine the level of conformity of the AWP&B by KFS as an organization. The study carried out evaluation of the performance of CFCs against their PCs targets as indicated in their AWP&B. The evaluation on the performance of field activities implemented establishes clear links across the study (Cooper & Shindler, 2011). The evaluation survey carried out allowed respondents the opportunity to comment in a qualitative open-ended questionnaire appended by giving general remarks on the perception on work performance and achievement emanating from interview. The evaluation was meant to assess the impact of AWP&B processes against PCs targets in line with KFS strategic plan targets. The study derived a correlation between funds allocation and performance of selected CFCs to identify the funding gap on the use of AWP&B and re-engineer feasible models for the system optimization for active engagement with exchequer for increased funding level base for deliverables of AWP&B. Lastly, the study reviewed and formulated the AWP&B of KFS that will be effective and efficient to negotiate for more funds from exchequer and enable attainment of PCs targets by CFCs.

3.3 Study Area

The study was carried out in selected seventeen (17) CFCs out of forty-seven (47) counties, in Kenya. Figure 3.1 below is a map of the Country of Kenya showing the boundary of the 47 CFCs and the study area.

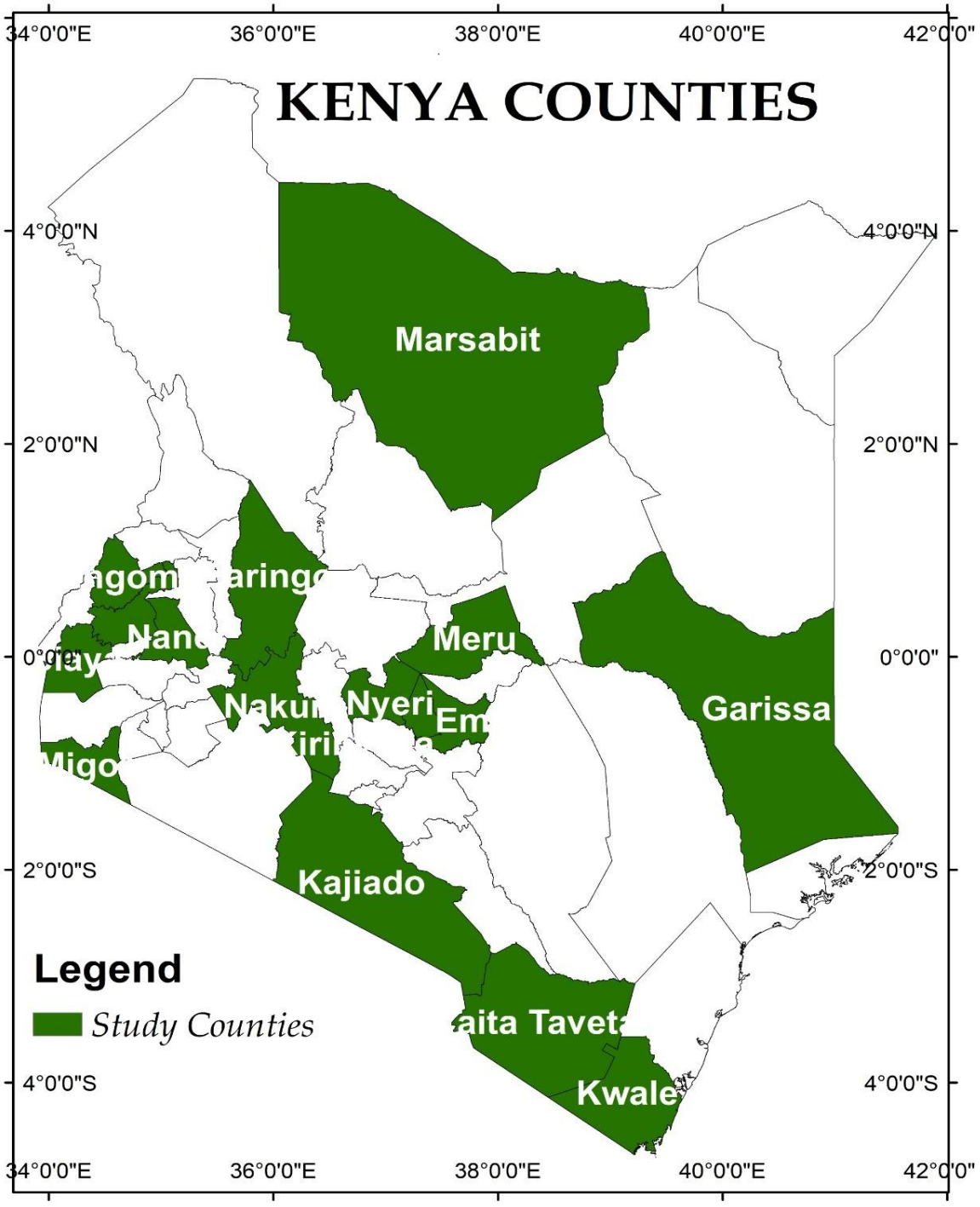

Figure 3.1: The map of study area of seventeen CFCs, in Kenya

(Source: KFS Strategic Plan 2017-2022)

3.4 Target Population

The study targeted CFCs of KFS. The CFCs implements AWP&B activities in line with KFS mandate, functions and government policy directions. According to First Schedule Article 6 (1) GOK, 2010 there are 47 counties in the country Kenya. There are 47 CFCs stationed at the KFS County Headquarters Offices all over the country. Apart from the CFCs who are in charge and responsibly for all the functional areas in the County, the study also involved the staffs of the County to respond to the questionnaire.

3.5 Sample and Sampling procedure

Subject to a sample of the population determination, the study displayed all the 47 characteristics of the population in order to be truly representative. Mugenda (2008) argued that for high precision pilots' studies, 10 per cent of the sample should constitute the pilot test size. Meanwhile, Mugenda and Mugenda, (2003) on quantitative and qualitative stationary approaches considered a threshold of 10-36 per cent sample size adequate for a descriptive study to respond to evaluation of the performance of the CFCs against their PCs targets as indicated in their AWP&B. The study adopted the upper threshold for better results according to Mugenda & Mugenda (2003) and calculated the area to be sampled as follow;

100% = 47 Counties,

therefore 36% = $(36 \; X \; 47)^{-100}$

=17 Counties (*sample size*)

The 17-sample size of CFCs determined from the above calculation were further stratified according to ten Regional Forest Conservancies (RFCs) who are regional management administrative division of a conservancy in KFS. These regional management administrative division were namely Nyanza, Central Highlands, Nairobi, Coast, Western, North Eastern, Eastern, North Rift, Mau and Ewaso North. Two counties were selected in each of the RFCs with the biggest number of counties and one county selected in each of the RFCs with the smallest number of counties as shown in table 3.1 below;

Table 3.1: Sampled counties in the Regional Forest Conservancy

Regional Forest Conservancy	Counties	Sampled Counties
1. Nyanza	1. Kisii	
	2. Migori	1. Migori
	3. Siaya	2. Siaya
	4. Kisumu	
	5. Nyamira	
	6. Homabay	
2. Central Highland	7. Laikipia	
	8. Kiambu	
	9. Murang'a	
	10. Kirinyaga	3. Kirinyaga
	11. Nyandarua	
	12. Nyeri	4. Nyeri
3. Nairobi	13. Nairobi	
	14. Kajiado	5. Kajiado
4.Coast	15. Kwale	6. Kwale
	16. Lamu	
	17. Mombasa	
	18. Tana River	
	19. Taita Taveta	7. Taita Taveta
	20. Kilifi	
5.Western	21. Bungoma	8. Bungoma
	22. Kakamega	9. Kakamega
	23. Vihiga	
	24. Busia	
6.North Eastern	25. Garissa	10. Garissa
	26. Wajir	
	27. Mandera	
7.Eastern	28. Embu	11. Embu
	29. Meru	12. Meru
	30. Tharaka Nithi	
	31. Machakos	
	32. Makueni	
	33. Kitui	
8.North Rift	34. Nandi	13. Nandi
	35. Trans Nzoia	14. Trans Nzoia
	36. Uasin Gishu	
	37. West Pokot	
	38. Turkana	
	39. Elgeyo Marakwet	
9.Mau	40. Baringo	15. Baringo
	41. Nakuru	16. Nakuru
	42. Narok	
	43. Kericho	
	44. Bomet	
10.Ewaso North	45. Marsabit	17. Marsabit
	46. Samburu	
	47. Isiolo	

(Source: Author, 2025)

17 sampling units were selected out of a total population of 47 and considered as a representative sample size for the study (Mugenda & Mugenda, 2003). The selected characters of the counties of the sampling unit were Kakamega, Garissa, Marsabit, Nakuru, Baringo, Nyeri, Taita/Taveta, Kwale, Embu, Kirinyaga, Bungoma, Kajiado, Trans Nzoia, Migori, Siaya, Nandi and Meru.

3.6 Data Collection instruments

The tool used to gather information in the study included questionnaires, survey, observations, checklists and secondary data. These instruments helped to collect, measure, and analyze data relevant to the study.

3.6.1 Data Validity

Data collection instrument used yielded data that enabled one draw meaningful inferences from the scores. It was able to measure intended content and the scores that predict a criterion measure and whether the scores obtained should be practical. The validity of the data was verified by research supervisors in line with the research objectives and research questions. They also checked for accuracy and quality to confirm that the data entered were correct data type.

3.6.2 Data Reliability

The reliability of a data set shows an indication of the stability and consistency with the instrument measure of the concept and helps to assess the goodness of a measure

(Sekaran, 2011). To maximize reliability of the study instruments, data collected was tested for relevance and consistency of results in order to minimize errors. Internal consistency was used to test responses that are consistent across board and that the administration of the questionnaire and scoring done with great care. All correlations were tested and retested. The reliability of the instrument was used to measure the degree to which the research instrument yields consistent results after repeated trials according to Mugenda and Mugenda (2003).

3.7 Data collection Procedure

The data collection procedure process typically involved defining the four (4) research questions in the study, selecting appropriate data collection that involved surveys, observations and administering questionnaire. The sample strategy was planned and ensured data were collected accurately and ethically with the goal to obtain reliable and valid data that can be systematically be managed and information analyzed to address the four (4) research questions in the study. The data collected were from primary and secondary sources.

3.8 Data Types and Data Sources

The study got understanding of data types and data sources for effective data analysis, processing and decision making.

3.8.1 Data Types

Data types were classified into categories based on operation that can be performed on it. These included text data describing characters of information, numeric data providing an achievement on performance and categorical data providing levels or category of performance.

3.8.2 Data Sources

Data sources were the origin of sources from which data was collected or obtained.

3.8.2.1 Primary data

The primary data for the study was collected from the sampled population using a questionnaire survey tool. The questionnaire was structured according to activities implemented in the field in response to AWP&B processes on performance of CFCs and realization of KFS strategic plan.

The following twelve activities were considered in the survey study on performance of seventeen (17) selected CFCs in Kenya; Tree seedlings production, plantation establishment, natural forests rehabilitation, farm and dryland forestry programme, bamboo establishment, partnership with private land owners, transition implementation plans, rehabilitation and maintenance of forest roads, ecotourism, way leaves and installations, silvicultural treatment, construction/refurbishment of ranger housing and revenue collection. An open-ended questionnaire was used to provide the standardized data that could be presented and analyzed.

3.8.2.2 Secondary data

The study involved gathering of secondary data from various governments' policy documents, and treasury guidelines as stipulated in the MTB process for funds allocation from exchequer. The study also looked at the forest sector prepared reports and returns on the subject matters. These secondary data were reviewed to allow for more reliability of the information obtained by facilitating triangulation of data from the surveys, observations, questionnaires and documents involved in the theoretical scheme for the interpretation of the phenomenon being studied (Sekaran, 2011). The study enhanced triangulation to facilitate validation of data through cross verification from more than two sources of data collection.

The study tested the consistency of findings obtained (e.g., the performance of CFCs against their PCs targets as indicated in their AWP&B) and increased the chance to control the analysis of the impact of AWP&B processes on expected results of the work performance of the CFCs. Data sources were authenticated as the true available information and due ethical considerations of informed consent, confidentiality and anonymity followed. In summary, these secondary data included but were not limited to government policy documents, treasury guidelines and circulars, various reports and returns which included fiscal financial year of AWP&B, MRA, and QRA, ARA, KFS strategic plans and annual reports. Other sources of secondary data considered in the study for information were books and data from other research findings of journal publications.

3.8.3 Data Pretesting and Piloting

The study used questionnaires to conduct the evaluation on performance pretesting and piloting one county to ensure that the questions being asked accurately reflected the information the study intended to get from the research questions and that the respondents could answer the questionnaire at ease. The data pretesting and piloting was in essence to provide ground work in the study.

According to Saunders *et al.* (2011), pilot pretesting refines the questionnaire survey tool on performance so that respondents will have no problems in answering the questions. To ascertain the validity and reliability of the questionnaire and interview guide, pretesting of the tool were carried out and pilot survey conducted prior to actual use of data tools in different piloted CFCs. This was to determine the survey tool appropriateness and revise any details where necessary. Saunders *et al.* (2011) observed that pilot testing establishes the accuracy and appropriateness of the research design and instruments and provides data for selection of a probability samples.

3.9 Data Analysis and Presentation

Data were prepared and checked for accuracy then presented using tables and figures as diagrammatic presentation and description. Raw data were appropriately put in readiness for analyses and organized to provide a means to introduce the interpretations into quantitative and qualitative methods (Mugenda, 2008). The variables were examined by asking respondents to respond to various statements and give their opinion and

perspective on the study on performance. To determine the findings of the study, the research undertook a series of data analyses on the following research objectives to answer the developed research questions in the study.

3.9.1 Conformity of the amalgamated AWP&B of KFS to requirements by the treasury guidelines as stipulated in the MTB process for funds allocation from exchequer

The study analyzed the conformity of the amalgamated AWP&B of KFS to requirements by the treasury guidelines as stipulated in the MTB process for funds allocation from exchequer to establish how efficiently and effectively the current amalgamated AWP&B of KFS contributes to achievement of government sector policies. This study was undertaken through a descriptive statistical data analysis at different levels of the empirical estimation of characteristic of economic relationships between AWP&B delivery and conformity requirement by the treasury guidelines. The levels which were considered in the study included national policy, national budget, expenditure management and results.

3.9.2 The performance of CFCs against their PCs targets as indicated in their AWP&B

The study evaluated the performance of CFCs against their PCs targets as indicated in their AWP&B to determine how robust the system support realization of KFS plans, strategies and policies. This study was undertaken using a rating indicator of the performance of selected seventeen (17) CFCs in Kenya as very satisfied *'3',* satisfied *'2'*

and not satisfied *'1'* with scoring percentages of *''80-100, 50-79 and 0-49''* respectively for the planned activities target against their PCs targets achievement as indicated in their AWP&B. The study undertook a inferential statistical data analysis to evaluate the performance of CFCs against their PCs targets as indicated in their AWP&B by applying Chi-square (χ^2) to test for the deviations of observed frequencies from expected frequencies on the categorical variables in the population on performance given by the equation below;

$$\chi^2 = [\ (f_o - f_e)^2]^{-fe}$$

where χ^2 = Chi-square statistics, f_e =expected frequency and f_o = observed frequency.

When χ^2 value = 0 it is said to be significant,

but when $\chi^2 > 1$ it is said to be insignificant.

3.9.3 Correlation between funds allocation and performance of CFCs

Data analysis for a correlation between funds allocation and performance of CFCs was done using Linear Programming (LP) model to determine optimization solution of fund allocation and performance CFCs. The LP issues included decision variables, objective function, constraints, and non-negativity limitations. The issues were subjected to Linear and Integer Programming (L&IP) software for optimization. The outcome of the LP model determined by the choice decision variables X1, X2, X3… and constraints C1, C2,

C3… which also reflected the ultimate solution. The aim of the objective function was to maximize performance by implementing the activities in the county while adhering to constraints due to limited fund allocation. The performance was in terms of the level of activities done. The LP assumption was that the relationship between variables were linear, which made it computationally tractable. System variances were considered to measure the CFCs ability to absorb the allocated funds to implement the AWP&B activities, timely recognition of problem and optimization to enhance work performance.

3.9.4 Formulating AWP&B to ensure effective and efficient and to negotiate for more funds from exchequer and enable attainment of PCs target by CFCs

The study formulated an AWP&B that will be effective and efficient to negotiate for more funds from exchequer and enable attainment of PCs target by CFCs. The improved AWP&B was to provide enabling environment to CFCs to realize implementation of her activities.

This study was undertaken through application of a descriptive data analysis of the established characteristics for the efficient and effective AWP&B as perceived by the respondents from the survey. The descriptive data analysis enabled the study to develop improved AWP&B processes that will enhance the work performance of the CFCs in the process of field activities implementation. This was to enable attainment of their PCs targets.

3.10 Ethical considerations

The ethical consideration prioritized participants rights, that included informed consent, confidentiality, anonymity, and potential harm, transparency in data collection and analysis. In this regard the researcher obtained prior permission before embarking on field work to conduct interviews and administer questionnaires to target respondents of management. The respondents were informed that the data collected responsibly shall be used purely for the academic purposes and shall not be divulged to unauthorized parties. That the data shall be handled with utmost confidentiality. The findings from the research work shall also be shared with the organizations once the study is finalized. Other ethical consideration observed by the researcher which were also crucial included maintaining trust, managing power dynamics and disclosing potential conflicts of interest.

CHAPTER FOUR

RESULTS

4.1 Introduction

This chapter presents the results based on the study carried out guided by research methodology. Section 4.2 provides for a response rate of percentage of CFCs who participated in the survey and provided usable responses out of the total number who were invited to participate. Section 4.3 provides descriptive statistics results and section 4.4 describes empirical results which are presented in an orderly and systematic manner for each of the specific objectives. These empirical results for the specific objectives include; presentation of analysis of determination of conformity of the amalgamated AWP&B of KFS to requirements by the treasury guidelines as stipulated in the MTB process for funds allocation from exchequer. The section demonstrates whether specific requirements by treasury have been fulfilled to ensure that the products and services are delivered as expected; the evaluation of the performance of CFCs against their PCs targets as indicated in their AWP&B; the correlation between funds allocation and performance of CFCs. The section provides an analysis of performance of CFCs by implementing the activities in the county while adhering to constraints due to limited fund allocation and feasible models for system optimization re-engineered and finally; the chapter provides for empirical results of formulation of a reviewed AWP&B that will be effective and efficient to negotiate for more funds from exchequer and enable attainment of PCs targets by CFCs.

4.2 Response rate

The results of response rate of percentage of CFCs who participated in the survey and provided usable responses out of the total number who were invited to participate was generally high. The database used comprises of 100% response rate from 17 CFCs out of 47 who were administered with one questionnaire on implementation of AWP&B of one financial year. The core objective for which the questionnaire was drawn up was to analyze the impact of AWP&B processes on performance of the CFCs. To that end, the questionnaire was divided in 12 major activities done in the field and require financial funding from the exchequer.

4.3 Descriptive statistics results

The study offered a concise summary of dataset's main features and presented data in a meaningful way. These results provided a clear picture of the data that helped researcher understand patterns, trends of responses without making generalization about a larger population. The descriptive statistics were broken down into measures of variability where Chi-square ($\chi 2$) statistical analysis was applied in the descriptive data to measure discrepancy between expected and obtained frequencies on performance of CFCs. The frequency measure of distribution of data for activities implemented by CFCs were organized using rating of; very good (3), satisfied (2), and not satisfied (1) of satisfaction on performance indicator (SPI). The scoring percentages were categorized as 80-100, 50-79, and 0-4 for rating of 3, 2, and 1 respectively (table 4.15).

4.4 Empirical estimation results

Empirical estimation results were presented in an orderly and systematic manner for each of the specific objectives. The following were empirical estimation results derived from real observations from a sample of data in the study;

4.4.1 Conformity of the amalgamated AWP&B of KFS to requirement by the treasury guidelines as stipulated in the MTB process for funds allocation from exchequer

Table 4.1 below shows results of identified requirements of engagement that conform to negotiations of examination of policy documents and treasury guidelines as stipulated in the MTB process for funds allocation from exchequer.

Table 4.1: Conformity of AWP&B processes as per engagement requirement by Treasury guidelines

No.	Engagement requirements	Observation
1.	Reform's priority reconciliation of AWP&B processes.	Clarity of policy direction on AWP&B processes to realize the SP activities
2.	Preparation of long-range plans and budgets that follow a definite budget procedure and implementation methodology.	Budget allocation reflect priorities in AWP&B activities.
3.	Shorter budgeting cycles preparation in the MTEF.	Consistency with approved budget.
4.	Segments finalization of planning and budget.	Positive effect of measurable output, outcome or impact for decision making.

(Source: Guidelines for finalizing the estimates for the FY 2021/22 and the MTB: The National Treasury and Planning Circular No.3/ 2021)

In the identified requirement above (table 4.1) for planning and budgeting process the study observed that the delivery outcome of programmes undertakes four (4) levels of approaches namely national policy, national budget, expenditure management and results (GOK, 2019) as highlighted in figure 4.1 below.

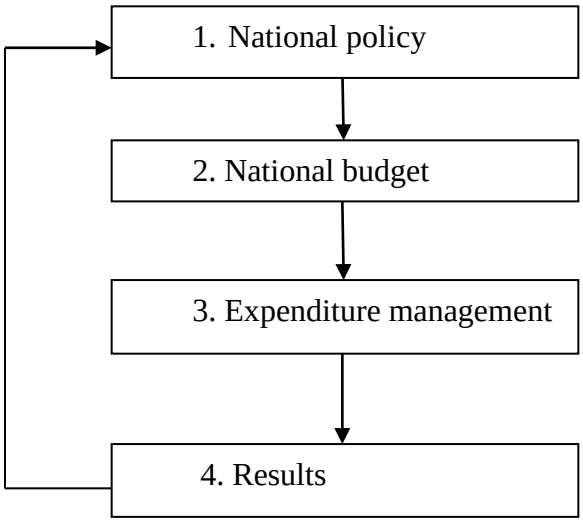

Figure 4.1: AWP&B delivery process

(Source: Guidelines for finalizing the estimates for the FY 2021/22 and the MTB: The National Treasury and Planning Circular No.3/ 2021)

1) **National policy level**: ensures clarity of policy direction on AWP&B to realize the SP activities.
2) **National budget level**: ensures that budget allocation reflect priorities in AWP&B activities.
3) **Expenditure management level**: ensures that spending is consistent with approved budget.

4) **Results level**: ensure feedback to national policy effect of measurable output, outcome or impact for decision making.

The study observed that AWP&B policy process as illustrated in the trend in the figure 4.1 above is a useful mechanism tool for proactive decision making that need to be subjected to the review and formulation of the current AWP&B structures.

The study noted that the national policy direction requires a preparation of SP often a five-year period to be implemented in the FFYs by the MDAs subjected to AWP&B for year 1, 2, 3, 4 and 5 prepared annually. However, key to the success of the SP targets is the ability of organization to mobilize the required resources. The trend shows the results of the preparation of the policy mechanism process of AWP&B is integrated into the MDAs resource management. The mechanism process commences with development of a national policy statement as a broad course of action of guidance to be adopted by the government at the national level in pursuit of national objective. The study noted that this is followed by a national budget reflecting an annual financial statement presenting the government proposed revenues and spending for a financial year MTEF preparation in line with MTP, vision 2030 and the Government agenda (GOK, 2007). Study noted that the finalized MTB is passed by the legislative, approved by the Chief Executive or President of the country and presented by the Finance Cabinet Secretary to the Nation.

According to GOK (2012) it requires the budget for the government to be publicized before it is released to the beneficiary segments. The study further noted that once the budgets have been released, the segments have to expedite expenditure management

where the tendency to promote the achievement of three outcomes, namely aggregate fiscal discipline, allocation efficiency and operational efficiency with end results of production of goods and services by employee often measured by objectives or standards (GOK, 2012). The negotiations at the national level for fund allocation from exchequer indicated the following non-conformity observation considered in the MTB in table 4.2 below;

Table 4.2: Non-Conformity of AWP&B processes as per consideration in MTB process of Treasury

No.	Consideration in MTB process	Observation
1.	Assumptions underpinning the MTB process fiscal structure;	Underperformance of delivery of goods and services to qualify for more funds.
2.	Priorities of the activities to be implemented in the FFYs;	Outputs and outcomes were not delivered within a tight fiscal environment (taxation, revenue, expenditure and debt).
3.	Form and content of budget to be negotiated for allocation;	Not fully presented by vote and workplan in accordance with section 38 (3) (b) of Public Finance Management Act, 2012
4.	Vote and programme budget ceiling of the activities to be funded;	Gaps in the approved budget resulting to constraints in the implementation of the AWP&B
5.	PPRs of AWP&B activities implemented.	Underperformance of non-financial indicators.

(Source: Guidelines for finalizing the estimates for the FY 2021/22 and the MTB: The National Treasury and Planning Circular No.3/ 2021)

The analysis of the requirements above (table 4.2) observed that MTB is officially initiated by the executive arm of government and approved by the legislative. The study analyzed the requirement of the MTB Policy structure used for negotiations to determine how amalgamated AWP&B of KFS conform to requirements by treasury guidelines as stipulated in MTB process for funds allocation from exchequer. The results of the analysis showed the following findings;

The 1st consideration in MTB process observation: The assumptions underpinning the FY 2021/22 and the MTB process were as highlighted in table 4.3 below;

Table 4.3: The assumptions underpinning the FY 2021/22 and MTB structure

Indicator	Assumption
Real GDP	Forecasted to grow at 3.8% in FY 2020/21 ;6.3% in FY 2021/22 and stabilize above 6.0% over the MTB
Inflation	Expected to be maintained within target of 5% over the MTB
Interest rate	To remain low and stable
Exchange rate	Safeguard exchange rate stability to achieve competitiveness in the MTB
Total revenue	Projected to increase from 14% of GDP in FY 2020/21 to over 18% in the MTB
Total expenditure	Expected to decline from 25.7% of the GDP in FY 2020/21 to 24.3% of GDP in FY 2021/22 and stabilize at around 22% of GDP in the MTB
Overall fiscal deficit	Expected to decline from 8.7% of the GDP in FY 2020/21 to 7.5% of the GDP in FY 2021/22 and stabilize around 4.3% of the GDP in the MTB

(Source: Guidelines for finalizing the estimates for the FY 2021/22 and the MTB: The National Treasury and Planning Circular No.3/ 2021)

The CFCs are expected to enhance efficiency, effectiveness and economy in delivery of public goods and services to qualify for more funds to run their planned activities in the MTB process. They are to deliver more outputs and outcomes with the availed allocated fund to them for their planned activities.

The 2nd consideration in MTB process: The priorities of the activities implemented in the FFYs by CFCs indicated that the outputs and outcomes are to be delivered within a tight fiscal environment, directing spending towards the most critical needs of the country, operating on a realistic resource envelope from the exchequer. The CFCs need to strengthen good governance, anti-corruption and public financial management reforms to guarantee transparency, accountability and efficiency in public spending of the funds allocated to them.

The 3rd consideration in MTB process: The form and content of budget implemented by CFCs showed that the AWP&B are presented by vote and work plan in accordance with section 38 (3) (*b*) of the Public Finance Management Act, 2012. The working groups in the fund's negotiation are required to review their programmes and align them to the mandates of the respective MDAs who are the beneficiary of fund allocation from exchequer. The findings of the current structure of AWP&B for funds negotiation in the context of form and content of budget ensured that;

Cross-cutting activities or functions which are not assigned to respective AWP&B are eliminated;

i. AWP&B with no clear outputs, key performance indicators and targets are not considered for fund allocation from exchequer;
ii. AWP&B retain their distinct name that reflects their overall objective;

iii. AWP&B performance targets are specific, measurable, achievable, realistic and time-bound (SMART) and;

iv. AWP&B performance indicators are mainly outputs or/and outcomes

The vote programme budget ceiling of the activities to be funded for Recurrent and Development for the Environment Protection, Water and Natural Resources Sector is provided in ‘‘Appendix V’’

The 4th consideration in MTB process: The vote and AWP&B ceiling of the activities implemented by the programmes gives a structure of negotiation within the context of Budget Policy Statement (BPS) which provides the spending limits of individual AWP&B that has been approved by the legislative. The MDAs are required to prioritize AWP&B requirement within which ceilings is contained and ensured that the allocated resources are aligned to interventions of Government Agenda and Economic Recovery Strategy (ERS).

The 5th consideration in MTB process: The PPRs of AWP&B implemented provides a detailed assessment of the process achieved towards realization of the targeted outputs after implementation of the MTB for the last three previous FFYs showing budgetary allocations, actual expenditure and achievement of actual outputs. The results further showed that PPRs reports indicates both financial and non-financial indicators of

performance for each programme and progress of both domestically and externally financed projects within a programme.

Table 4.4, 4.5 and 4.6 below provided estimates of funds required by KFS to implement her 1st, 2nd and 3rd SP over the planned fiscal financial periods 2009-2014, 2014-2017 and 2017-2022 respectively. Potential sources of funds were identified to come mainly from exchequer, development partners, appropriation in Aid (A.I.A) and private sectors. The budgetary requirements for SP implementation in the tables 4.4, 4.5 and 4.6 indicate that there were limitations of funding allocation from exchequer in the specific FFYs of implementing periods despite KFS plans identifying strategic objectives for implementations of her AWP&B.

Table 4.4: Budgetary Requirement for SP implementation for FFYs 2010-2014

FFYs Ending								
No	**Source of Funds**	**Type of Budget**	**2009-10 Kshs M**	**2010-11 Kshs M**	**2011-12 Kshs M**	**2012-13 Kshs M**	**2013-14 Kshs M**	**Total Kshs M**
1	GOK	Recurrent	1,693.94	1,694.84	1,864.33	1,957.54	2,055.42	**9,266.07**
		Development	392.16	234.76	249.21	257.37	265.94	**1,399.06**
2	External	Recurrent	0.00	0.00	0.00	0.00	0.00	**0.00**
		Development	772.98	1,078.91	1,100.00	1,100.00	1,100.00	**5,151.89**
3	KFS Revenue	Recurrent	192.50	191.60	300.00	500.00	800.00	**1,984.10**
		Development	0.00	808.40	1,700.00	2,500.00	2,700.00	**7,708.40**
4	Others	Recurrent	0.00	0.00	0.00	0.00	0.00	**0.00**
		Development	7.55	6.30	6.30	6.30	6.30	**32.75**
Subtotals		Recurrent	1,886.44	1,886.44	2,164.33	2,457.54	2,855.42	**11,250.17**
		Development	1,172.69	2,127.99	3,055.51	3,863.67	4,072.24	**14,292.11**
Grand Total			**3,059.13**	**4,014.43**	**5,219.83**	**6,321.22**	**6,927.66**	**25,542.28**

(Source: KFS Strategic Plan 2010-2014)

Table 4.5: Budgetary Requirement for SP implementation for FFYs 2014-2017

FFYs Ending									
Source of funding	**2014/15 (Actual) Kshs in Millions**			**2015/16 (Actual) Kshs in Millions**			**2016/17 (Estimates) Kshs in Millions**		
	REC	**DEV**	**TOTAL**	**REC**	**DEV**	**TOTAL**	**REC**	**DEV**	**TOTAL**
Exchequer	1,637	511	2,149	1,637	468	2,105	1,800	491	2,291
Dev. Partners	-	463	437	-	581	581	-	582	582
A-in-A	2,336	-	2,318	2,599	-	2,599	2,700	-	2,700
Private Sector	-	-	-	-	-	-	-	-	-
Total Funding	3,973	975	4,903	4,237	1,049	5,286	4,500	1,073	5,573
Funds Needed	4,400	5,200	9,600	5,000	9,500	14,500	5,000	10,100	15,100
Funding Gap	427	4,225	4,697	763	8,451	9,214	500	9,027	9,527

(Source: KFS Strategic Plan 2014-2017)

Table 4.6: Budgetary Requirement for SP implementation for FFYs 2017-2022

Source of funding	FFYs Ending																	
	2017/2018 (Estimates) Kshs in Millions				2018/2019(Estimates) Kshs in Millions				2019/2020 (Estimates) Kshs in Millions				2020/2021(Estimates) Kshs in Millions				2021/2022(Estimates) Kshs in Millions			
	REC	DEV (Programme	DEV (Projects)	TOTAL	REC	DEV (Programme	DEV (Projects)	TOTAL	REC	DEV (Programme	DEV (Projects)	TOTAL	REC	DEV (Programme s)	DEV (Projects)	TOTAL	REC	DEV (Programme s)	DEV (Projects)	TOTAL
Exchequer	1,937	583	205	2,725	1,987	680	245	2,912	2,047	950	295	3,292	2,112	1,050	280	3,442	2,187	1,100	210	3,497
Development Partners	0	0	867	867	0	0	984	984	0	0	1,184	1,184	0	0	1,500	1,500	0	0	1,550	1,550
A-in-A	3,200	0	0	3,200	3,250	100	0	3,350	3,300	150	0	3,450	3,350	170	0	3,520	3,400	200	0	3,600
Private Sector	0	50	0	50	0	65	0	65	0	70	0	70	0	72	0	72	0	73	0	73
Total Funding Available	5,137	633	1,072	6,842	5,237	845	1,229	7,311	5,347	1,170	1,479	7,996	5,462	1,292	1,780	8,534	5,587	1,373	1,760	8,720
Funds Requirements	5,700	720	1,200	7,620	5,850	950	1,350	8,150	5,950	1,450	1,650	9,050	5,600	1,600	1,850	9,050	5,800	1,800	2,180	9,780
Funding Gap	-563	-87	-128	-778	-613	-105	-121	-839	-603	-280	-171	-1,054	-138	-308	-70	-516	-213	-427	-420	-1,060

(Source: KFS Strategic Plan 2017-2022)

The total budget for 1st, 2nd and 3rd of KFS SP were Kshs 25.5, 39.2 and 43.65 respectively in billions. The trend showed an increase in percentages of 54% and 11% as shown in the figure 4.2 below on total budget allocation against the 1st, 2nd and 3rd of KFS SP over the planned FFYs period;

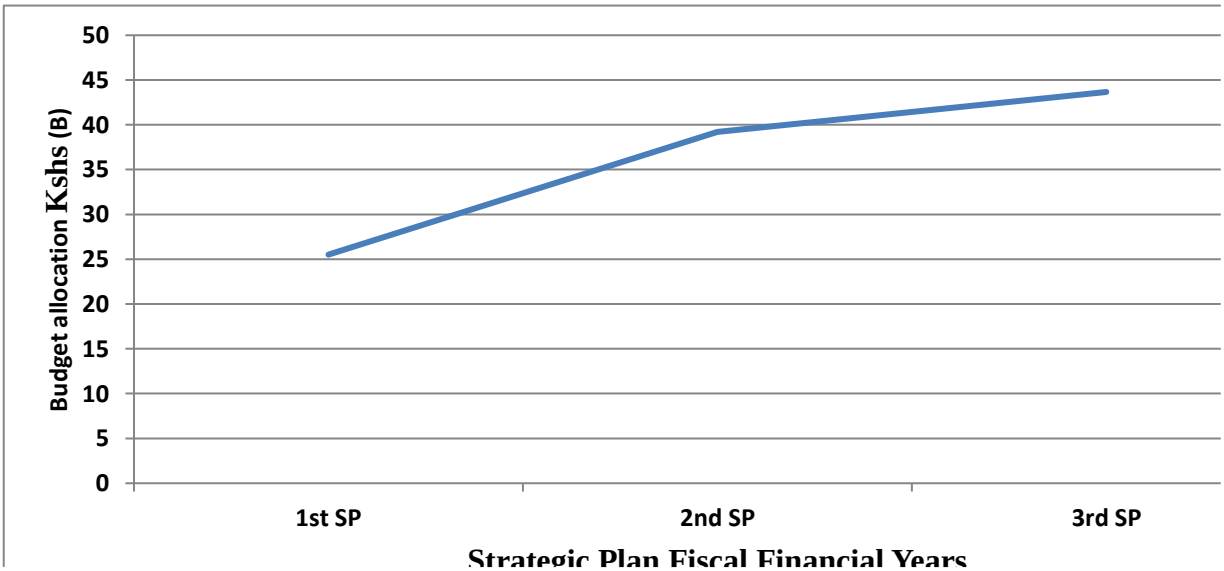

Figure 4.2: Total budget allocation over the planned FFYs period of SP

(Source: KFS Strategic plan 2010-2014, 2014-2017 and 2017-2022)

4.4.2 The performance of CFCs against their PCs targets as indicated in their AWP&B

Evaluation of performance of CFCs against their PCs targets as indicated in their AWP&B was carried out to track the implementation and achievement of AWP&B. The results indicated that CFCs executes the implementation of the AW&B and manages the forest resources under their jurisdiction to realize their PCs targets. Further, they have

knowledge that subjects them on the necessity to apply the AWP&B. They have used the system aligning it with a FY committed in PC and the strategic plan targets of the FFY period.

The following were the results of Key Performance Indicators implemented (KPI) by CFCs with the allocated funds observed with the rating of very satisfied ‘3’, satisfied ‘2’ and not satisfied ‘1’ of Satisfaction on Performance Indicator (SPI) with scoring percentages of ‘‘80-100, 50-79 and 0-49’’ respectively for the PCs targets as indicated in their AWP&B against achievement;

1. Tree Seedlings

Table 4.7: Tree seedlings production, achievement and performance indicators by CFCs

No.	CFCs Office	No KFS Nurseries	No Stakeholder Nurseries	AWP&B Target seedlings '000	KFS Achievement ''000''	Stakeholders Achievement ''000''	Total AWP&B Achievement ''000''	Satisfaction on Performance Indicator (3, 2 or 1)
1	Kakamega	7	132	6,080	1,060	5,020	6,080	3
2	Garissa	2	0	25	28	0	28	3
3	Marsabit	5	0	60	59	0	59	3
4	Nakuru	6	239	7,900	1,070	5,730	6,800	3
5	Baringo	11	40	6,600	2,400	4,200	6,600	3
6	Nyeri	12	128	4,200	1,700	2,500	4,200	3
7	Taita Taveta	5	88	2,100	313	981	1,294	2
8	Kwale	5	43	220	55.6	226.39	282	3
9	Embu	3	55	1,500	200	469	669	1
10	Kirinyaga	5	60	4,800	1,300	3,000	4,300	3
11	Bungoma	5	20	1,400	325	1,000	1,325	3
12	Kajiado	2	90	2,000	500	1500	2,000	3
13	Trans Nzoia	8	69	6,000	2,331	3,369	5,700	3
14	Migori	6	94	2,000	148	1,451	1,599	3
15	Siaya	2	96	2,800	300	2,500	2,800	3
16	Nandi	7	70	8,100	2,000	6,000	8,000	3
17	Meru	10	34	2,870	1,870	2,000	3,870	3
	Total	**94**	**1,258**	**58,655**	**15,660**	**39,946**	**55,606**	**3**

(Source: Author, 2025)

The result from table 4.7 above shows that;

a. From the primary data sampled for tree seedlings production in various counties, KFS produced about 25% of total seedlings while the stakeholders produced about 75%. In essence for every one (*1*) seedling produced by KFS, Stakeholders produce three (*3*). The low seedling production in KFS nurseries was found to be attributed to insufficient funding and inadequate staff.
b. Seedlings tubes in many cases have been bought by the saw millers where there is timber exploitation (*Nyeri, Baringo, Nakuru, and Kirinyaga*).
c. Most of the CFCs have reported that they do not receive allocation for seedling production for major programmes namely natural forest conservation for enrichment planting, plantation establishment and farm and dryland forestry development as planned in the activities-based budgets. Where there is availability of funds, they were inadequate.
d. Most of the nurseries have old staffs working in them and mostly two members of staffs only in nearly all KFS nurseries indicating inadequate availability of personnel for efficient productivity.
e. Where there were no natural streams, water was a major problem e.g., in Siaya, Baringo.
f. High potential areas recorded high seedling production rates than the low potential areas indicating favorable environmental conditions for attainment of optimal results e.g., Nakuru, Baringo, Nyeri, Kakamega, Nandi, Kirinyaga, Trans Nzoia.

g. All the CFCs implemented the activity of seedling production to enhance provision of tree seedlings (production) for tree planting indicating focused social responsibility of the implementers.

The figure 4.3 below shows tree seedling production performance indicators by CFCs. From observation, the performance indicator of most CFCs is in level 3 “Very satisfied” apart from two Counties namely Taita Taveta and Embu whose performance indicators are in level 2 “Satisfied” and 1 “Not satisfied”

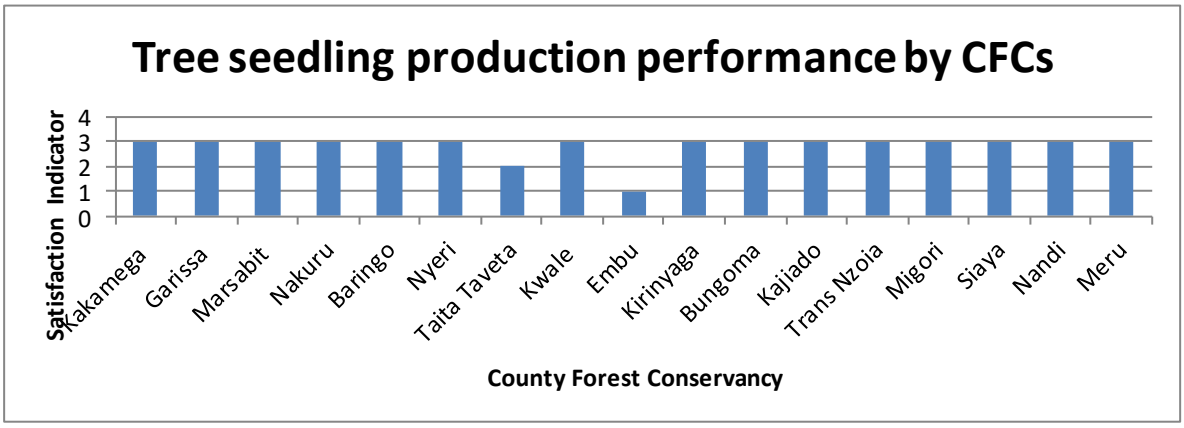

Figure 4.3: Tree seedlings production performance by CFCs

(Source: Author, 2025)

2. Plantation Establishment

Table 4.8: Plantation establishment, achievement and performance indicators by CFCs

No.	CFCs Office	AWP&B Target area (Ha)	AWP&B Achievement (Ha)	Satisfaction on Performance Indicator (3, 2 or 1)
1	Nyeri	440	378	3
2	Kajiado	100	100	3
3	Trans Nzoia	1300	1300	3
4	Nandi	480	480	3
5	Baringo	2500	1000	1
6	Kwale	50	60	3
7	Bungoma	220	390	3
8	Kirinyaga	31	19	2
9	Meru	800	527	2
10	Embu	40	70	3
11	Migori	10	19	3
12	Kakamega	527	200	1
	Total	**6,498**	**4,543**	**2**

(Source: Author, 2025)

The result from table 4.8 above shows that;

a. Plantation establishment target for the Counties were 6,498 ha, although the actual planting on the ground were 4,543 ha. The results showed an achievement of 70%

which qualified for an indicator of ‘‘2’’. The Counties achievement was accomplished mostly with resources provided by stakeholders as there was inadequate or no fund allocation for plantation establishment in the Counties.

b. The previous established plantations were not surveyed and therefore, there were no entries into the compartment registers across the stations. This indicated lack of attainable planned activity targets for the set goals and objectives.
c. Compartment registers were not up to date and showed no prescriptions by the CFCs as required in the Technical Orders.
d. No sketch survey maps for plantations established.
e. There were no survival counts of planted areas in almost all the stations sampled
f. Low survival rate of plantations established was observed during the field inspection.
g. Sub-compartment boundaries and firebreaks had been lost in many of the forest stations as the Plantation Establishment and Livelihood Improvement Scheme (PELIS) was practiced in disregard to these boundaries.
h. In Baringo (Narasha Forest Station) it was noted that there was much bigger area under PELIS (estimated 1000 ha under cultivation) which was not reported.
i. Illegal grazing in Kiptunga Forest Station was noted to be severe and there were no records on whether there were payments of the service for grazing.
j. CFCs were not providing prescriptions for plantations as required in the technical orders.

k. CFAs and Saw millers were providing most of the inputs needed to produce seedlings for plantation establishment including labour indicating sound socio-economic status benefits of the enterprise to local community.

l. There was illegal mining of gold in both natural forests and plantation areas in Kibiri Forest Station in Vihiga County.

m. It was not possible to determine the plantation areas established using KFS allocated resources in the entire county visited indicating lack of accountability of KFS resources utilization for organization to run effectively.

n. Plantation establishment was practiced only by counties with high potential areas. As at the time of evaluation of the performance, the soil moisture builds up was still low for planting. However, the results showed that plantations established during the previous financial year recorded low survival. This was attributed to prolonged drought, termite attack on young seedlings and poor supervision during planting.

The figure 4.4 below shows plantation establishment performance indicators by CFCs. From observation, the performance indicator of most CFCs is in level 3 “Very satisfied” apart from two Counties namely Kirinyaga and Meru whose performance indicators are in level 2 “Satisfied” and Baringo and Kakamega in level 1“Not satisfied”.

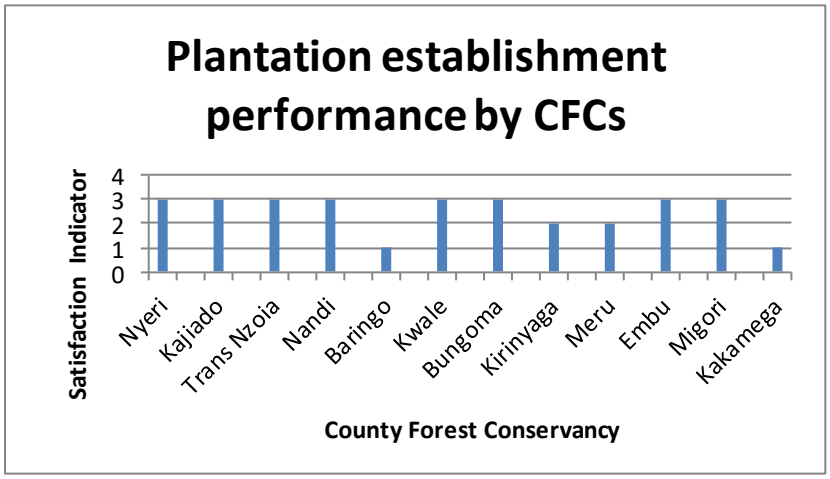

Figure 4.4: Plantation establishment performance by CFCs

(Source: Author, 2025)

3. Natural Forests Rehabilitation

Table 4.9: Natural Forest rehabilitation through enrichment planting, achievement and performance indicators by CFCs

No.	CFCs Office	AWP&B Target area (Ha)	AWP&B Achievement (Ha)	Satisfaction on Performance Indicator (3, 2 or 1)
1	Kajiado	67	60	3
2	Marsabit	200	120	2
3	Garissa	1	0	1
4	Bungoma	12	50	3
5	Kirinyaga	130	130	3
6	Meru	110	131	3
7	Siaya	30	1	1
8	Nandi	43	50	3
9	Trans Nzoia	100	96	3
10	Kakamega	85	85	3
	Total	**778**	**723**	**3**

(Source: Author, 2025)

The results from table 4.9 above show that;

a) Overall target for the Counties were 778 ha for natural forest rehabilitation through enrichment planting and the actual achievements on the ground were 723

ha. The results showed an achievement of 93% which qualified for an indicator of '3'.

b) However, it was noted that all the counties had identified degraded areas but have not zoned and mapped them for rehabilitation. This was a serious problem across the counties as resources were spent on rehabilitation without clear zoned and mapped out areas.

c) It was observed that most invasive species in the forests were *Lantana camara* (*Kwale, Trans Nzoia, Migori, and Nandi*), *Prosopis juliflora* (*Garissa, Baringo*) and the areas occupied by these invasive species were not surveyed for proper management.

The figure 4.5 below shows natural forest rehabilitation performance indicator by CFCs. From observation, the performance indicator of most CFCs is in level 3 "Very satisfied" apart from three Counties namely Marsabit whose performance indicator is in level 2 "Satisfied" and Garissa and Siaya in level 1 "Not satisfied"

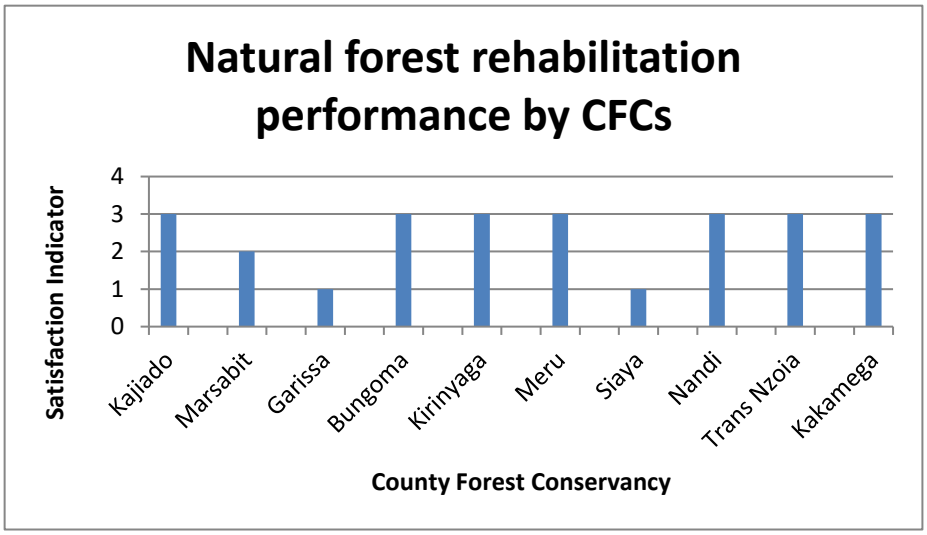

Figure 4.5: Natural Forest rehabilitation performance by CFCs

(Source: Author, 2025)

4. Farm and Dryland Forestry Programme

Table 4.10: Commercial farm forests establishment, achievement and performance indicators by CFCs

No.	CFCs Office	Area (Ha)	No. of Nurseries	No. of Seedlings	AWP&B Target (Ha)	AWP&B Achievement	Satisfaction on Performance Indicator (3, 2 or 1)
1	Siaya	25,000	170	1,523,220	300	80	1
2	Marsabit	-	8	35,000	50	30	2
3	Kirinyaga	-	-	-	500	406	3
4	Nandi	225,000	106	6,328,040	500	0	1
5	Meru	-	24	471,888	300	0	1
6	Embu	-	58	129,750	50	50	3
7	Kakamega	-	-	-	750	0	1
8	Garissa	629	-	-		-	-
9	Trans Nzoia	77,176	-	-	-	-	-
10	Baringo	1,030,300	-	-	-	-	-
11	Migori	107.54	-	-	-	-	-

(Source: Author, 2025)

The results from table 4.10 above shows:

a) An overall satisfaction on performance indicator as ‘1’ despite having area to carry out the activity and enough seedlings to be planted.
b) Garissa, Trans Nzoia, Baringo and Migori show a nil report on number of nurseries, number of seedlings, target area and achievement despite having areas to carry out the activity. This indicates that KFS has no direct control of the activity outside Gazetted forests.
c) Accessibility of locality of site to carry out the activity is lacking.
d) Good state of activity with guidance process for implementation is lacking in most counties resulting in either failure to implement the planned activity or lack of reporting what has been achieved.
e) Moreover, the preferred species for commercial farm forestry was *Gravellia robusta, Eucalyptus grandis, Eucalyptus camaldulensis and casuarina equestifolia*.

The figure 4.6 below shows commercial farm forests establishment performance by CFCs. From observation, the performance indicators of most CFCs are generally in level 1 “Not satisfied”

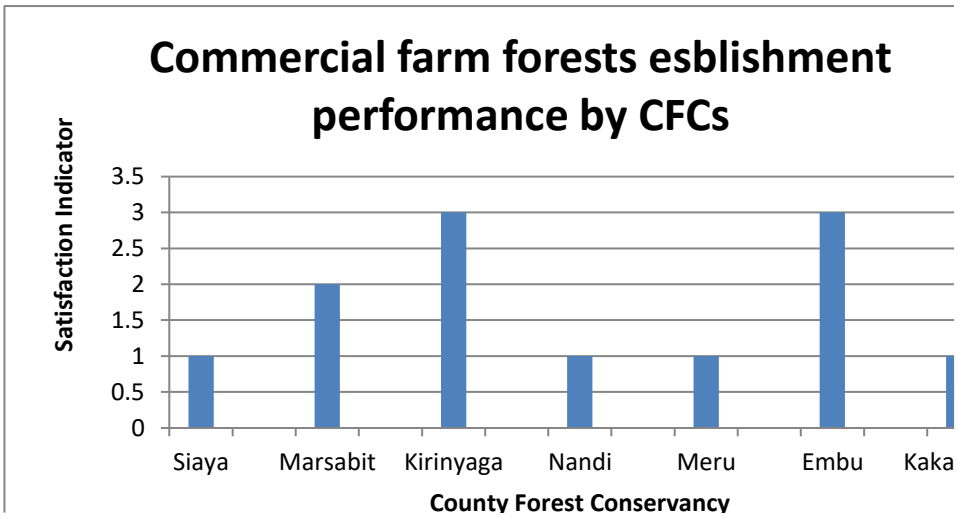

Figure 4.6: Commercial farm forests establishment performance by CFCs

(Source: Author, 2025)

5. Bamboo Establishment

Table 4.11: Bamboo seedlings production and performance indicators by CFCs

No.	CFCs Office	No of Nurseries	No. of Seedlings Production	Remarks	Satisfaction on Performance Indicator (3, 2 or 1)
1	Siaya	1	150	-	2
2	Nyeri	1	100	-	2
3	Trans Nzoia	1	1,142	-	3
4	Nakuru	1	2,500	*Dendrocalmus spp, Yushania alpina*	3
5	Nandi	1	3,000	Seedlings sourced from private nurseries	3
6	Kirinyaga	1	1,530	-	3
7	Taita Taveta	1	550	Produced 550 seedlings and sold 500 to Ngoloki Secondary School	2
8	Kwale	1	0	All seedlings dried up,	1
9	Meru	1	1000	-	3
10	Kakamega	1	2,000	-	3
11	Bungoma	1	50	-	1
12	Embu	1	1,400	-	3
	Total	**12**	**13,422**	**-**	**3**

(Source: Author, 2025)

The results from table 4.11 above show that:

a) Bamboo establishment was being promoted in most of the counties visited and observations indicated that satisfaction on performance was overally '*3*'
b) In most of the counties there was lack of attainable planned targets for the set goals and objectives.
c) Taita Taveta County produced and sold 91% of its bamboo seedling stock indicating a readily available market for the produced seedlings and positive sound socio-economic status benefits of the bamboo production enterprise to local schools.
d) The 100% bamboo seedlings raised by Kwale County dried up in the nursery indicating lack of favorable environment conditions for attainment of optimal results.

The figure 4.7 below shows bamboo seedling production performance by CFCs. From observation, the performance indicator of most CFCs is in level 3 "Very satisfied" with the rest falling in level 2 "Satisfied" and 1 "Not satisfied"

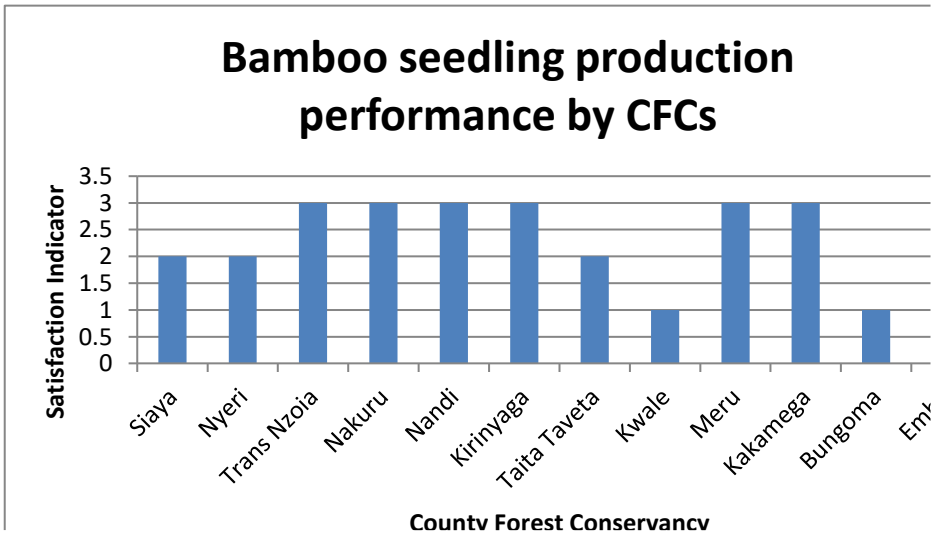

Figure 4.7: Bamboo seedling production performance by CFCs

(Source: Author, 2025)

6. Partnership with Private Land Owners

There were no private registered forests in the counties visited. The explanation was that there were no guidelines for registration of private forests. There were also no formal partnerships between KFS and private land owners observed. However, the partnership was intended to promote sound socio-economic benefits of the enterprise to private land owners and enhance the attainment of the 10% tree cover in the country.

7. Transition Implementation Plans

The Transition Implementation Plans (TIP*s*) were intended to facilitate the smooth transfer of the devolved forest functions of Farm and Dryland Forestry Programme to County Government. It was observed that the plans were prepared jointly with county governments. Only two out of the seventeen counties had signed the TIPs. Neither of the

two had operationalized the plans. The reason for this was that counties had no competent staff employed to carry out the functions.

8. Rehabilitation and Maintenance of Forest Roads

Table 4.12: Rehabilitation and maintenance of forest roads, achievement and performance indicators by CFCs

No.	CFCs Office	AWP&B Target area (Km) for Roads Grading	AWP&B Achievement (Km) for Roads Grading	Satisfaction on Performance Indicator (3, 2 or 1)
1	Nyeri	74	30	1
2	Kajiado	43	16	1
3	Trans Nzoia	70	26	1
4	Nandi	62	24	1
5	Baringo	57	22	1
6	Kwale	40	14	1
7	Bungoma	45	20	1
8	Kirinyaga	52	23	1
9	Meru	62	27	1
10	Embu	42	14	1
11	Migori	32	12	1
12	Kakamega	48	22	1
	Total	**627**	**250**	1

(Source: Author, 2025)

Rehabilitation and maintenance of forest roads activities specified in the AWP&B for the CFCs included graveling, roads grading, bush clearing, manual shaping, culvert cleaning, cleaning drains, culvert installation and culvert manufacture. The main activity of roads grading from the table 4.12 above shows a very low-keyed rehabilitation and maintenance of forest roads on the ground with a generated descriptive of satisfaction on performance indicator '1' and scoring percentage below 50%.

The figure 4.8 below shows rehabilitation and maintenance of forest roads performance by CFCs. From observation, the performance indicators of all CFCs are in level 1 "Not satisfied"

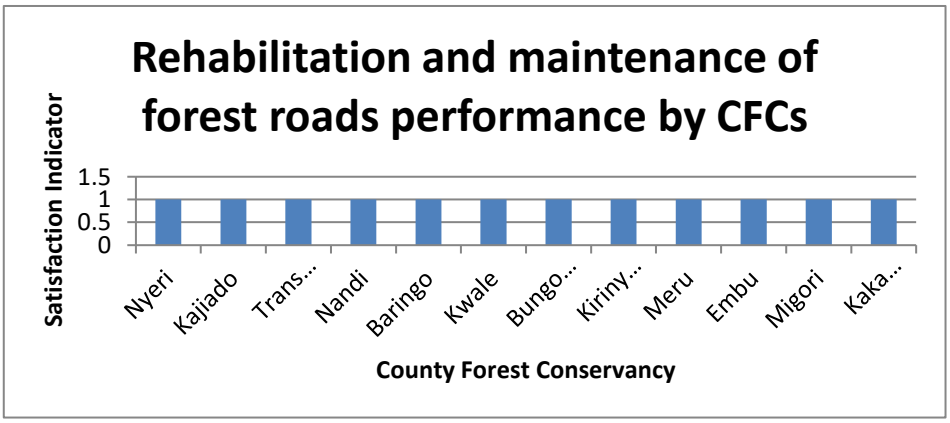

Figure 4.8: Rehabilitation and maintenance of forest roads performance by CFCs

(Source: Author, 2025)

9. Ecotourism, Way Leaves and Installations

Information on these facilities of ecotourism, way leaves and installations were crucial for sustainable management of the forests. However, the finding on the ground revealed that the officers in charge do not have adequate data on ecotourism facilities, way leaves and installations. The officers referred to the headquarters for any information needed on licensing terms and conditions.

10. Silvicultural Treatment

Table 4.13: Pruning and thinning operation in plantations, achievement and performance indicators by CFCs

No.	CFCs Office	AWP&B Target (Ha)	AWP&B Achievement (Ha)	Satisfaction on Performance Indicator (3, 2 or 1)
1	Vihiga	36 (Pruning) 86 (Thinning)	0 0	1
2	Bungoma	18.5 (Pruning)	18.5	3
3	Migori	6.9 (Pruning) 14.4 (Thinning)	6.9 14.4	3
4	Nandi	226 (Pruning)	194.25	3
5	Trans Nzoia	496.28 (Pruning)	205.6	1
6	Kakamega	613 (Pruning) 68 (Thinning)	205.6 48	2

(Source: Author, 2025)

Silvicultural treatment on plantations aimed to improve the quality of timber produced. These operations were documented and entered into the compartment registers to provide the history of management of each of the plantations. However, observed result from table 4.13 above shows that:

a) There were delayed pruning and thinning across many of the field stations visited on account that most of these treatments, in all the forest areas were carried out by stakeholders mainly the CFAs.
b) Supervision of these operations was very poor.
c) There were lack of attainable planned activities targets for the set goals and objective of the implementation.
d) There was lack of good state of activities with a guidance process for implementation.

The figure 4.9 below shows pruning and thinning operation in plantations performance by CFCs. From observation, the performance indicator of CFCs falls in level 3 “Very satisfied” level 2 “Satisfied” and level 1 “Not satisfied”

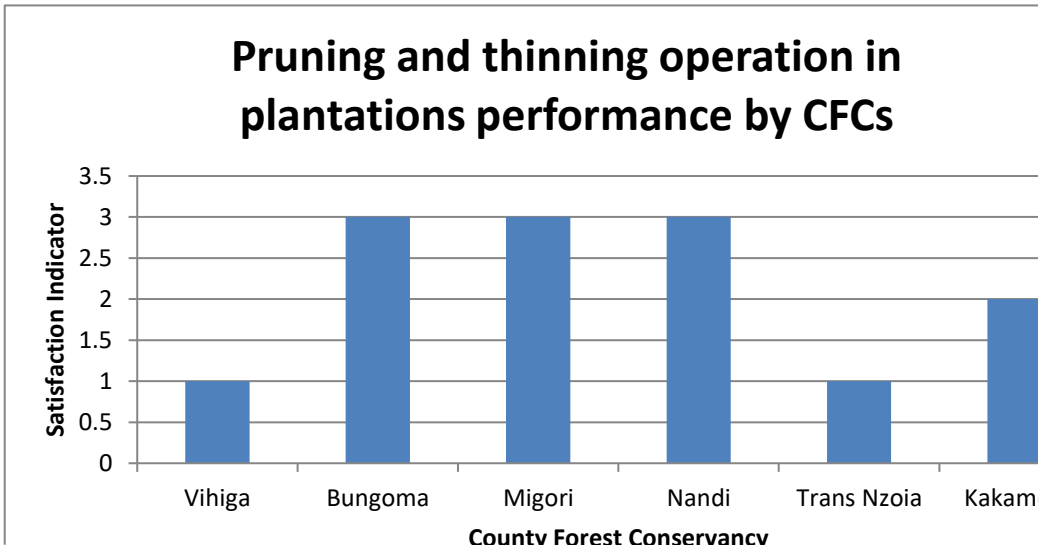

Figure 4.9: Pruning and thinning operation in plantations performance by CFCs.

(Source: Author, 2025)

11. Construction/Refurbishment of Ranger Housing

Rangers' duties were a crucial component of protection of forest areas. The officers needed decent housing with basic facilities for human habitation. New construction of rangers' houses was noted in Marsabit where 4 houses of 2- bedrooms each and in Nakuru where 6 houses of 2-bedrooms each were constructed. The Marsabit rangers' houses were funded by the Northern Kenya Biodiversity Project while in Nakuru was fully financed by KFS. The construction in Nakuru was allocated a total of Kshs 19 million and was 90% complete as at the time of the evaluation of performance whereas the cost for the Marsabit houses could not be ascertained.

With regard to refurbishment, 46 counties were each allocated Kshs 1,086,000 for the refurbishment of at least six houses for the rangers. Out of the 17 counties sampled, only 4 had refurbishment works for ranger houses ongoing while the rest had nothing to report as at the evaluation of performance. The works in the four counties was at different levels of completion with both Nyeri and Kirinyaga having about 90% completion.

12. Revenue

Table 4.14: Revenue collection, achievement and performance indicators by CFCs

No.	CFCs Office	AWP&B Target (Million Kshs)	AWP&B Achievement (Million Kshs)	Satisfaction on Performance Indicator (3, 2 or 1)
1	Kajiado	19.00	17.00	3
2	Marsabit	1.40	1.00	3
3	Garissa	1.00	1.40	3
4	Kirinyaga	35.00	31.00	3
5	Meru	130.00	123.00	3
6	Siaya	0.20	0.14	2
7	Embu	10.00	9.00	3
8	Migori	4.00	2.70	2
9	Nandi	52.00	42.00	3
10	Trans Nzoia	1I.57	15.17	3
11	Kakamega	59.00	58.00	3
	Total	**311.6**	**300.41**	**3**

(Source: Author, 2025)

The results from the table 4.14 above shows that the planned target for revenue collection from the counties was Kshs 311.6 million out of which Kshs 300.4 million was realized. This was an achievement of 96% giving a satisfaction on performance indicator of '*3*'.

It was observed that the ideal situation was that revenue should be collected and receipted at the point of sale of a product or service. While this was happening for many of the products sold by KFS, payments for installations, way leaves and ecotourism facilities were remitted directly at the head office. This was causing difficulties of monitoring such payments for the field officers in whose jurisdiction the facilities were located. The mode of payment of revenue in the field was a cashless system: cheques, pay bill or electronic fund transfer (EFT). It was also noted that one challenge encountered in the field was internet network failures for payment through pay bill which affected revenue flow and inconvenienced the customers. Moreover, for customers with no access to mobile money services particularly the tourists, other payments methods e.g., card swiping could be devised.

In the rural villages some community members collecting fuelwood from the forest did not have mobile phones as such they were unable to pay using phones. According to the Communication Commission of Kenya about 30% of Kenyans do not have access to mobile phone communication.

The figure 4.10 below shows revenue collection performance by CFCs. From observation, the performance indicators of most CFCs are in level 3 “Very satisfied” apart from two Counties namely Siaya and Migori whose performance indicators are in level 2 “Satisfied”.

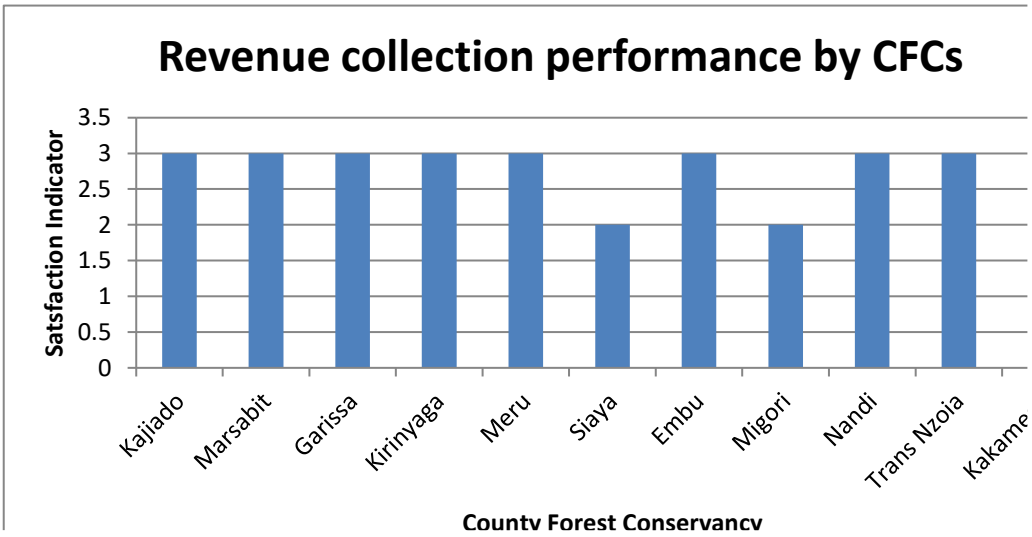

Figure 4.10: Revenue collection performance by CFCs.

(Source: Author, 2025)

In consistence with the above results the univariate statistical analysis was applied to activities on above tables 4.7, 4.8, 4.9, 4.10, 4.11, 4.12, 4.13 and 4.14 in seeking to analyze data variances in order to measure the CFCs ability in satisfaction of field work performance. Descriptive answers were classified in three categories ‘‘very satisfied (3), satisfied (2) and not satisfied (1)’’ providing the degrees of freedom of assessment to two (*2*) i.e., 3-1 with the scoring percentage of ‘‘80-100, 50-79 and 0-49’’ respectively for the planned activities and achievement of the AWP&B given by;

$$\alpha = 0.05$$

$$V = k-1$$

Where V is the degree of freedom;

k is the number of categories on satisfaction response assessment.

Table 4.15 below shows the results of impact of the assessment with frequency of expected (*target*) and observed (*achievement*) on eight activities namely seedling production, plantation establishment, natural forest rehabilitation, farm and dryland forestry, bamboo establishment, rehabilitation and maintenance of forest roads, silvicultural and treatments activities and revenue collection. The study observed that the remaining four activities subjected to evaluation of performance namely partnership with private land owners, transition implementation plans, ecotourism, way leaves and installations and construction/refurbishment of rangers housing recorded a minimal information or nil return on performance evaluation.

Table 4.15: AWP&B Performance satisfaction of the activities

Category of activity	Frequency (F)	Very Satisfied (3)	Satisfied (2)	Not Satisfied (1)	n
1. Seedling production	F_o	15	1	1	17
	F_e	88.0	6.0	6.0	100
2. Plantation establishment	F_o	8	2	2	12
	F_e	66.6	16.7	16.7	100
3. Natural forest rehabilitation	F_o	7	1	2	10
	F_e	70	10	20	100
4. Farm and dryland forestry	F_o	2	1	4	7
	F_e	29	14	57	100
5. Bamboo establishment	F_o	7	3	2	12
	F_e	58	25	17	100
6. Rehabilitation and maintenance of forest roads	F_o	0	0	12	12
	F_e	0	0	100	100
7. Silvicultural and treatments activities	F_o	3	1	2	6
	F_e	50	17	33	100
8. Revenue collection	F_o	9	2	0	11
	F_e	82	18	0	100

(Source: Author, 2025)

The study applied Chi-square (χ^2) analysis to check if two categorical variables are related or independent to help understand if the data differs significantly from the expected data. Chi-square ($\chi 2$) test statistic was computed and compared to a critical value. The Critical value for the Chi-square statistic was determined by the level of significance (*0.05*) and the degrees of freedom (*2*).

Assumptions of the Chi-square

1) The data in the cells should be frequencies, or count of cases rather than percentages or some other transformation of the data.
2) The levels (or categories) of the variables are mutually exclusive.
3) Each subject may contribute data to one and only one cell in the $\chi 2$.

The analysis of the descriptive data measuring discrepancy between expected and obtained frequencies of performance of the CFCs given by equation:

$$\chi^2 = [(f_o - f_e)^2]^{-fe}$$

Where χ^2 = Chi-square test of independence

f_e =expected value of categorical variable

f_o = observed value of categorical variable

The tests of categorical variables revealed the following activity results on performance:

a) Seedling production

$$\text{Degrees of freedom} = v = k-1 = 3-1 = 2$$

$$\text{Thus } \chi^2 = [(15 - 88)^2]^{-88} + [(1 - 6)^2]^{-6} + [(1 - 6)^2]^{-6}$$

$$= 60.56 + 4.17 + 4.17 = 68.90 \ldots\ldots\ldots\

$$= 44.8448 + 19.36 + 13.2353 = 77.44 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (v)$$

f) Rehabilitation and Maintenance of Forest Roads

$$\text{Degrees of freedom} = v = k-1 = 3-1 = 2$$

$$\text{Thus } \chi^2 = [(0 - 0)^2]^{-0} + [(0 - 0)^2]^{-0} + [(12 - 100)^2]^{-100}$$

$$= 0.00 + 0.00 + 77.44 = 77.44 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (vi)$$

g) Silvicultural treatments

$$\text{Degrees of freedom} = v = k-1 = 3-1 = 2$$

$$\text{Thus } \chi^2 = [(3 - 50)^2]^{-50} + [(1 - 17)^2]^{-17} + [(2 - 33)^2]^{-33}$$

$$= 44.18 + 15.0588 + 29.1212 = 88.36 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (vii)$$

h) Revenue collection

$$\text{Degrees of freedom} = v = k-1 = 3-1 = 2$$

The statistics is given by equation $\chi^2 = [(f_o - f_e)^2]^{-fe}$ where χ^2 = Chi-square statistics, f_e =expected frequency and f_o = observed frequency.

$$\text{Thus } \chi^2 = [(9 - 82)^2]^{-82} + (2 - 18)^2]^{-18} + [(0 - 0)^2]^{-0}$$

$$= 64.9878 + 14.2222 + 0.00 = 79.21 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (viii)$$

The Chi-Square ($\chi 2$) calculated value statistics i, ii, iii …viii above were 68.90, 77.44, 82.85, 86.49, 77.44, 77.44, 88.36 and 79.21 respectively. From ‘‘Appendix C’’ on critical values of Chi-Square (χ^2) distribution table, a critical value of the Chi-Square (χ^2) distribution of 5.99 having probabilities of occurrences reflected;

$$P(\chi^2 \geq 5.99) = 0.05$$

$$0.025 < P < 0.05,$$

The result on evaluation on performance showed that the observed calculated Chi-square ($\chi 2$) test statistics (79.78) was greater than the critical value (5.99) at 95% ($\alpha = 0.05$). Test result was found to be significant showing the performance of CFCs did not support full realization of their PCs targets as indicated in their AWP&B.

4.4.2.1 Achievement of the performance of CFCs against their PCs targets as indicated in their AWP&B

An institutional theory approach with twelve activities for implementation underlies the theoretical factors influencing the achievement of the PCs targets of CFCs as indicated in their AWP&B.

The data collected from selected CFCs reflected the following nine factors that tend to influence the AWP&B enhancement for work performance improvement as perceived by the respondents. AWP&B processes has the following advantages:

i. Gives you control over the planning and budget
ii. Keeps you focused on planning and budget goals
iii. Makes you aware what is going on with your planning and budget

iv. Helps you organize your spending and savings

v. Make you decide in advance how your planning and budget will work for you

vi. Enables you to save for expected and unexpected costs

vii. Provides you with an early warning for potential problems

viii. Helps you determine if you can request for subsidiary fund and how much

ix. Enables you to produce according to your target

4.4.3 Correlation between funds allocation and performance of CFCs

Table 4.16: Budgetary requirement against total amount of funds allocated for activities in FY by CFCs

No.	CFCs	No. of activities implemented	Total amount requested for the activities (Kshs)	Total amount allocated for the activities (Kshs)
1	Kakamega	7	32,292,550	29,000,000
2	Garissa	3	12,029,540	11,000,000
3	Marsabit	3	16,347,000	14,000,000
4	Nakuru	5	17,603,738	11,000,000
5	Baringo	4	16,360,800	11,000,000
6	Nyeri	4	18,920,560	14,000,000
7	Taita Taveta	2	1,726,450	700,000
8	Kwale	5	15,816,500	14,000,000
9	Embu	6	22,739,920	21,000,000
10	Kirinyaga	7	27,391,004	25,000,000
11	Bungoma	6	29,728,600	21,000,000
12	Kajiado	5	21,497,000	18,000,000
13	Trans Nzoia	6	26,352,300	25,000,000
14	Migori	5	19,532,420	18,000,000
15	Siaya	4	19,130,320	18,000,000
16	Nandi	7	32,042,182	29,000,000
17	Meru	6	26,137,040	25,000,000
Total		**85**	**355,647,924**	**304,700,000**

(Source: Author, 2025)

The table 4.16 above shows the results of budgetary requirement of activities implemented by the CFCs against total amount of funds allocated in 2021/2022 FY.

The implemented activities include; tree seedling production, plantation establishment, natural forest rehabilitation, commercial farm forest establishment, bamboo seedling production, rehabilitation and maintenance of forest roads and silvicultural treatment (pruning).

4.4.3.1 Feasible models for the AWP&B system optimization

In the model, the system essentially seeks out to minimize the total fixed and variable costs to the work performance of the CFCs activities. In order to minimize the total fixed and variable costs to the performance of the CFCs activities and ensure effective and efficient deployment of existing resources for capability maximization, Linear Programming (LP) model was used to determine optimization solution of fund allocation and performance with assumption that relationships between variables are linear, which makes it computationally tractable.

Note 1: Every optimization problem had three components;

a) An objective function

b) Decision variables

c) Constraints

Note 2: Characteristics of LP problems

a) A decision amongst alternative courses of action is required.

b) The decision is represented in the model by decision variables.

c) The problem encompasses a goal, expressed as an objective function, that the decision maker wants to achieve.

d) Restrictions (represented by constraints) exist that limit the extent of achievement of the objective.

e) The objective and constraints must be definable by linear mathematical functional relationships.

Note 3: **Properties of LP models**

a) Proportionality - The rate of change (slope) of the objective function and constraint equations is constant.

b) Additivity - Terms in the objective function and constraint equations must be additive.

c) Divisibility -Decision variables can take on any fractional value and are therefore continuous as opposed to integer in nature.

d) Certainty - Values of all the model parameters are assumed to be known with certainty (non-probabilistic).

In order to explore the capability of optimal maximization, the following data analysis and results from seventeen CFCs below were realized;

1. CFC: Kakamega

Problem statement for feasible models for the AWP&B system optimization for county number one.

a) To produce 1,000,000 tree seedlings with a unit cost of Kshs 5.50 per tree seedling production.

b) To establish 300Ha of plantation with a unit cost of Kshs 22,194.00 per hectare of establishment.

c) To rehabilitate 85Ha of natural forests with a unit cost of Kshs 22,194.00 per hectare of rehabilitation.

d) To establish 750Ha of commercial farm forests with a unit cost of Kshs 14,400.00 per hectare of establishment.

e) To produce 1,000 bamboo seedlings with a unit cost of Kshs 9.00 per bamboo seedling production.

f) To rehabilitate and maintain 48Km of forest roads with a unit cost of Kshs 50,000.00 per kilometer of rehabilitation and maintenance.

g) To do a silvicultural treatment (Pruning) of 613Ha with a unit cost of Kshs 8,220.00 per hectare of silvicultural treatment.

h) To determine optimal solution of activities viable to be implemented in the county that minimizes the costs and increases the level of satisfaction of performance.

Table 4.17: LP model 1 optimization formulation and solution

Objective function	
The aim of the objective function is to maximize performance by implementing the seven activities in the county while adhering to constraints of budget, raw materials cost, labour cost and machine operation cost due to limited fund allocation. The performance is in terms of the level of activities done.	
MaxZ:5,500,000X1+ 6,658,200X2+1,886,490X3+10,800,000X4+9,000X5 +2,400,000X6+ 5,038,860X7 ≥ 32,292,550	
Where; Z is the objective function that should be maximized.	
X1, X2, X3, X4, X5, X6, X7 are decisions variables (The activities to be implemented) which are; Tree seedling production, Plantation establishment, Natural Forest rehabilitation, Commercial farm forest establishment, Bamboo seedling production, Rehabilitation and maintenance of forest roads and Silvicultural treatment (Pruning) respectively.	
The coefficient of X1, X2, X3, X4, X5, X6, X7 are the unit cost of the decision's variables for the above activities.	
The objective function is subject to the following constraint equations:	
No	**Constraint equation**
1	Budget constraint: 5.5X1+22,194X2+22,194X3+14,400X4+9X5+50,000X6+8,220X7 ≤ 29,000,000
2	Raw materials cost constraint: 0.8X1+1.6X5 ≤ 801,600
3	Labour cost constraint: 22,194X2+22,194X3+14,400X4+8,220X7 ≤ 24,383,550
4	Machine operation cost constraint: 50,000X6 ≤ 2,400,000
5	Non-negativity constraints: X1, X2, X3, X4, X5, X6 and X7 ≥ 0

(Source: Author, 2025)

Table 4.17 above shows the results of LP model 1 optimization formulation and solution. It provides identified objective function with seven (7) decision variables and eleven (11) constraints and explicitly states the non-negativity restriction used for writing down the optimization model.

Table 4.18: Results of LP model 1, solved using L&IP software

	08:30:24		Sunday	June	09	2024		
	Decision Variable	Solution Value	Unit Cost or Profit c[j]	Total Contribution	Reduced Cost	Basis Status	Allowable Min. c[j]	Allowable Max. c[j]
1	X1	1.002.000,0000	5.500.000,0000	5.511.000.000.000,0000	0	basic	5.500,0000	M
2	X2	0	6.658.200,0000	0	-15.535.800,0000	at bound	-M	22.194.000,0000
3	X3	0	1.886.490,0000	0	-20.307.510,0000	at bound	-M	22.194.000,0000
4	X4	0	10.800.000,0000	0	-3.600.000,0000	at bound	-M	14.400.000,0000
5	X5	2.609.889,0000	9.000,0000	23.489.000.000,0000	0	basic	6.750,0000	9.000.000,0000
6	X6	0	2.400.000,0000	0	-58.589.000,0000	at bound	-M	60.989.000,0000
7	X7	0	5.038.860,0000	0	-3.181.140,0000	at bound	-M	8.220.000,0000
	Objective	Function	(Max.) =	5.534.489.000.000,0000				
	Constraint	Left Hand Side	Direction	Right Hand Side	Slack or Surplus	Shadow Price	Allowable Min. RHS	Allowable Max. RHS
1	C1	29.000.000,0000	<=	29.000.000,0000	0	1.000,0000	5.511.000,0000	M
2	C2	801.600,0000	<=	801.600,0000	0	6.868.125,0000	0	4.218.182,0000
3	C3	0	<=	24.383.550,0000	24.383.550,0000	0	0	M
4	C4	0	<=	2.400.000,0000	2.400.000,0000	0	0	M
5	C5	1.002.000,0000	>=	0	1.002.000,0000	0	-M	1.002.000,0000
6	C6	0	>=	0	0	0	-M	0
7	C7	0	>=	0	0	0	-M	0
8	C8	0	>=	0	0	0	-M	0
9	C9	2.609.889,0000	>=	0	2.609.889,0000	0	-M	2.609.889,0000
10	C10	0	>=	0	0	0	-M	0
11	C11	0	>=	0	0	0	-M	0

(Source: Author, 2025)

The results of L&IP are shown in table 4.18 above. According to the results, the solution value of decision variables X1 and X5 are Kshs 1,002,000.0000 and Kshs 2,609,889.0000. respectively. It means that it is viable to produce 1,000,000 of tree

seedlings and bamboo seedlings in the CFC. The other variables X2, X3, X4, X6 and X7 are not economically viable based on the parameter value of the objective function and constraints. The results also show that the reduced cost of these activities X2, X3, X4, X6 and X7 are Kshs -15,535,800.0000, Kshs -20, 307,510.0000, Kshs -3,600,000.0000, Kshs -58,589,000.0000 and Kshs -3,181,140.0000 respectively. It means that if these values are added to the correspondent parameter values on the objective function, these activities will be viable to be implemented. The shadow cost of the other constraints is zero. However, the one-unit changes of this constraints do not affect implementation of these activities. The slack variables introduced into the linear constraints of LP were identified as positive for candidate solution, and therefore the particular constraints were non-binding there in the model, as constraints do not restrict the possible changes from that point.

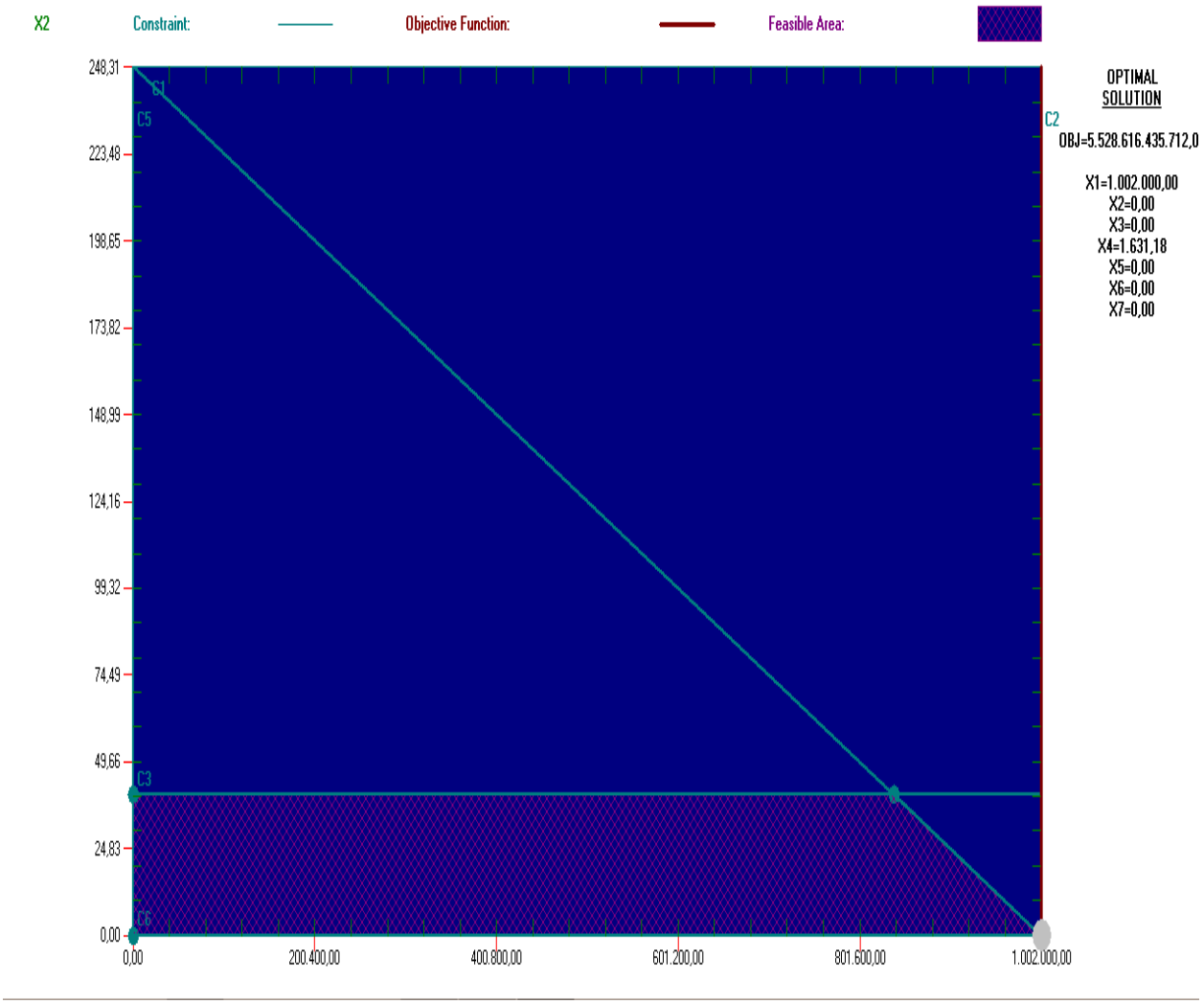

Figure 4.11: Graphical solution of LP model 1 showing feasible region

(Source: Author, 2025)

Figure 4.11 above of Graphical solution of LP model 1, the results show the visualized region shaded providing an optimal solution with objective function value of maximization equals to Kshs 5,528,616,435,712.00 with X1 equals to Kshs 1,002,000.00, X2 equals to Kshs 0.00, X3 equals to Kshs 0.00, X4 equals to Kshs 1,631.18, X5 equals to Kshs 0.00, X6 equals to Kshs 0.00 and X7 equals to Kshs 0.00.

The intersecting region in the graph reflects the decision feasible region as a result of plotting the inequalities in the XY graph. The feasible region provides the optimal solution as well as what all values the model takes in the optimization as shown in the figure 4.11 above. The feasible solution region on the graph is one which is satisfied by the constraints viewed as the intersection of valid region. The optimum point (**.**) at the intersection gives the values of the decision variables necessary to optimize the objective function after subjecting the values of the parameters into the equation of the objective function. This process results in proving the optimal solution of the problem as indicated o-n the left side of the graph above.

The value of the basic variables keeps transforming to obtain the maximum value for the objective function. The optimal solution is found when all the coefficients in the objective row are non-negative. This means that the LP model clearly provides optimal performance that will lead to lasting output especially allocation of enough fund for better implementation of the activities towards achievement of planned targets.

2. CFC: Garissa

Problem statement for feasible models for the AWP&B system optimization for county number two.

a) To produce 500,000 tree seedlings with a unit cost of Kshs 5.50 per tree seedling production.

b) To rehabilitate 10Ha of natural forests with a unit cost of Kshs 22,194.00 per hectare of rehabilitation.

c) To establish 629Ha of commercial farm forests with a unit cost of Kshs 14,400.00 per hectare of establishment.

d) To determine optimal solution of activities viable to be implemented in the county that minimizes the costs and increases the level of satisfaction of performance.

Table 4.19: LP model 2 optimization formulation and solution

Objective function	
The aim of the objective function is to maximize performance by implementing the three activities in the county while adhering to constraints of budget, raw materials cost and labour cost due to limited fund allocation. The performance is in terms of the level of activities done.	
MaxZ:2,750,000X1+ 221,940X2+9,057,600X3 ≥ 12,029,540	
Where; Z is the objective function that should be maximized.	
X1, X2, X3 are decisions variables (The activities to be implemented) which are; Tree seedling production, Natural Forest rehabilitation and Commercial farm forest establishment respectively.	
The coefficient of X1, X2, X3 are the unit cost of the decision's variables for the above activities.	
The objective function is subject to the following constraint equations:	
No	**Constraint equation**
1	Budget constraint: 5.5X1+22,194X2+14,400X3 ≤ 11,000,000
2	Raw materials cost constraint: 0.8X1 ≤ 400,000
3	Labour cost constraint: 22,194X2+14,400 X3 ≤ 9,279,540
4	Non-negativity constraint: X1, X2 and X3 ≥ 0

(Source: Author, 2025)

Table 4.19 above shows the results of LP model 2 optimization formulation and solution. It provides identified objective function with three (3) decision variables and seven (7) constraints and explicitly states the non-negativity restriction used for writing down the optimization model.

Table 4.20: Results of LP model 2, solved using L&IP software

	13:58:09		Friday	June	07	2024		
	Decision Variable	Solution Value	Unit Cost or Profit c[j]	Total Contribution	Reduced Cost	Basis Status	Allowable Min. c[j]	Allowable Max. c[j]
1	X1	400.000,0000	2.750.000,0000	1.100.000.000.000,0000	0	basic	3.459,5000	M
2	X2	0	221.940,0000	0	-13.738.090,0000	at bound	-M	13.960.030,0000
3	X3	611,1111	9.057.600,0000	5.535.200.000,0000	0	basic	144.000,0000	7.200.000.000,0000
	Objective	Function	(Max.) =	1.105.535.000.000,0000				
	Constraint	Left Hand Side	Direction	Right Hand Side	Slack or Surplus	Shadow Price	Allowable Min. RHS	Allowable Max. RHS
1	C1	11.000.000,0000	<=	11.000.000,0000	0	629,0000	2.200.000,0000	11.479.540,0000
2	C2	400.000,0000	<=	400.000,0000	0	2.746.541,0000	312.810,9000	2.000.000,0000
3	C3	8.800.000,0000	<=	9.279.540,0000	479.540,0000	0	8.800.000,0000	M
4	C4	400.000,0000	>=	0	400.000,0000	0	-M	400.000,0000
5	C5	0	>=	0	0	0	-M	0
6	C6	611,1111	>=	0	611,1111	0	-M	611,1111
7	C7	0	<=	0	0	0	0	M

(Source: Author, 2025)

The results of L&IP are shown in table 4.20 above. According to the results, the solution value of decision variables X1 and X3 are Kshs 400,000.0000 and Kshs 611.1111 respectively. It means that it is viable to produce 500,000 tree seedlings and establish 629 Ha of commercial farm forests in the CFC. The other variable X2 is not economically

viable based on the parameter value of the objective function and constraints. The results also show that the reduced cost of these activities X2 Kshs -13,738,090.0000 It means that if this value is added to the correspondent parameter value on the objective function, this activity will be viable to be implemented. The shadow cost of the other constraints is zero. However, the one-unit changes of this constraints do not affect implementation of these activities. The slack variables introduced into the linear constraints of LP were identified as positive for candidate solution, and therefore the particular constraints were non-binding there in the model, as constraints do not restrict the possible changes from that point.

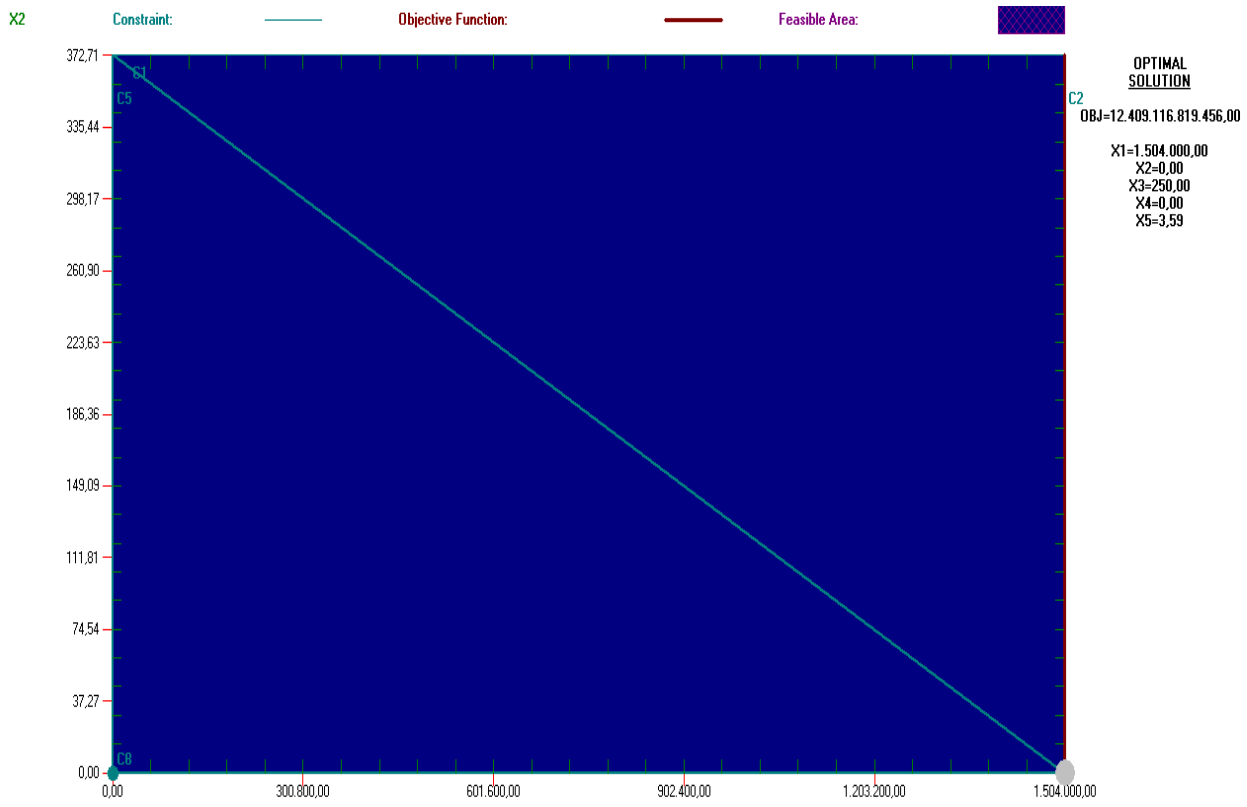

Figure 4.12: Graphical solution of LP model 2 showing feasible region

(Source: Author, 2025)

Figure 4.12 above of Graphical solution of LP model 2, the results show the visualized region shaded providing an optimal solution with objective function value of maximization equals to Kshs 12,409,116,819,456.00 with X1 equals to Kshs 1,504,000.00, X2 equals to Kshs 0.00, X3 equals to Kshs 250.00, X4 equals to Kshs 0.00 and X5 equals to Kshs 3.59.00.

The intersecting region in the graph reflects the decision feasible region as a result of plotting the inequalities in the XY graph. The feasible region provides the optimal solution as well as what all values the model takes in the optimization as shown in the figure 4.12 above. The feasible solution region on the graph is one which is satisfied by the constraints viewed as the intersection of valid region. The optimum point (**.**) at the intersection gives the values of the decision variables necessary to optimize the objective function after subjecting the values of the parameters into the equation of the objective function. This process results in proving the optimal solution of the problem as indicated on the left side of the graph above.

The value of the basic variables keeps transforming to obtain the maximum value for the objective function. The optimal solution is found when all the coefficients in the objective row are non-negative. This means that the LP model clearly provides optimal performance that will lead to lasting output especially allocation of enough fund for better implementation of the activities towards achievement of planned targets.

3. CFC: Marsabit

Problem statement for feasible models for the AWP&B system optimization for county number three.

a) To produce 300,000 tree seedlings with a unit cost of Kshs 5.50 per tree seedling production.

b) To rehabilitate 500Ha of natural forests with a unit cost of Kshs 22,194.00 per hectare of rehabilitation.

c) To establish 250Ha of commercial farm forests with a unit cost of Kshs 14,400.00 per hectare of establishment.

d) To determine optimal solution of activities viable to be implemented in the county that minimizes the costs and increases the level of satisfaction of performance.

Table 4.21: LP model 3 optimization formulation and solution

Objective function	
The aim of the objective function is to maximize performance by implementing the three activities in the county while adhering to constraints of budget, raw materials cost and labour cost due to limited fund allocation. The performance is in terms of the level of activities done.	
MaxZ:1,650,000X1+ 11,097,000X2+3,600,000X3 ≥ 16,347,000	
Where; Z is the objective function that should be maximized.	
X1, X2, X3 are decisions variables (The activities to be implemented) which are; Tree seedling production, Natural Forest rehabilitation and Commercial farm forest establishment respectively.	
The coefficient of X1, X2, X3 are the unit cost of the decision's variables for the above activities.	
The objective function is subject to the following constraint equations:	
No	**Constraint equation**
1	Budget constarint:5.5X1+22,194X2+14,400X3 ≤ 14,000,000
2	Raw materials cost constraint: 0.8X1 ≤ 240,000
3	Labour cost constraint: 22,194X2+14,400 X3 ≤ 12,686,490
4	Non-negativity constraint: X1, X2 and X3 ≥ 0

(Source: Author, 2025)

Table 4.21 above shows the results of LP model 3 optimization formulation and solution. It provides identified objective function with three (3) decision variables and seven (7) constraints and explicitly states the non-negativity restriction used for writing down the optimization model.

Table 4.22: Results of LP model 3, solved using L&IP software

	14:17:29		Friday	June	07	2024		
	Decision Variable	Solution Value	Unit Cost or Profit c[j]	Total Contribution	Reduced Cost	Basis Status	Allowable Min. c[j]	Allowable Max. c[j]
1	X1	240.000,0000	1.650.000,0000	396.000.000.000,0000	0	basic	2.750,0000	M
2	X2	571,3256	11.097.000,0000	6.340.000.000,0000	0	basic	5.548.500,0000	6.658.200.000,0000
3	X3	0	3.600.000,0000	0	-3.600.000,0000	at bound	-M	7.200.000,0000
	Objective	Function	(Max.) =	402.340.000.000,0000				
	Constraint	Left Hand Side	Direction	Right Hand Side	Slack or Surplus	Shadow Price	Allowable Min. RHS	Allowable Max. RHS
1	C1	14.000.000,0000	<=	14.000.000,0000	0	500,0000	1.320.000,0000	14.006.490,0000
2	C2	240.000,0000	<=	240.000,0000	0	1.647.250,0000	238.820,0000	2.545.455,0000
3	C3	12.680.000,0000	<=	12.686.490,0000	6.490,0000	0	12.680.000,0000	M
4	C4	240.000,0000	>=	0	240.000,0000	0	-M	240.000,0000
5	C5	571,3256	>=	0	571,3256	0	-M	571,3256
6	C6	0	>=	0	0	0	-M	0
7	C7	0	<=	0	0	0	0	M

(Source: Author, 2025)

The results of L&IP are shown in table 4.22 above. According to the results, the solution value of decision variables X1 and X2 are Kshs 240,000.0000 and Kshs 571.3256 respectively. It means that it is viable to produce 300,000 of tree and rehabilitate 500 Ha natural forests in the county. The other variable X3 is not economically viable based on the parameter value of the objective function and constraints. The results also show that

the reduced cost of these activity X3 is Kshs -3,600,000.0000. It means that if this value is added to the correspondent parameter value on the objective function, this activity will be viable to be implemented. The shadow cost of the other constraints is zero. However, the one-unit changes of this constraints do not affect implementation of these activities. The slack variables introduced into the linear constraints of LP were identified as positive for candidate solution, and therefore the particular constraints were non-binding there in the model, as constraints do not restrict the possible changes from that point.

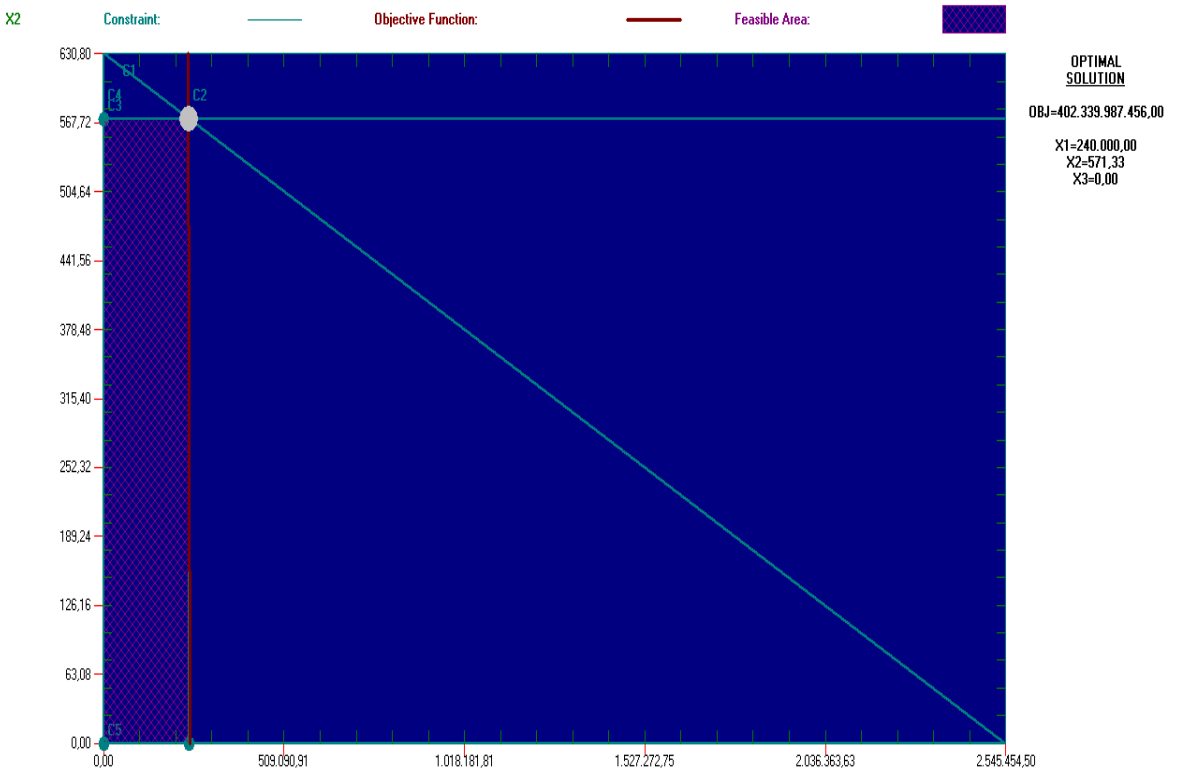

Figure 4.13: Graphical solution of LP model 3 showing feasible region

(Source: Author, 2025)

Figure 4.13 above of Graphical solution of LP model 3, the results show the visualized region shaded providing an optimal solution with objective function value of maximization equals to Kshs 402,339,987,456.00 with X1 equals to Kshs 240,000.00, X2 equals to Kshs 571.33 and X3 equals to Kshs 0.00.

The intersecting region in the graph reflects the decision feasible region as a result of plotting the inequalities in the XY graph. The feasible region provides the optimal solution as well as what all values the model takes in the optimization as shown in the figure 4.13 above. The feasible solution region on the graph is one which is satisfied by the constraints viewed as the intersection of valid region. The optimum point (**.**) at the intersection gives the values of the decision variables necessary to optimize the objective function after subjecting the values of the parameters into the equation of the objective function. This process results in proving the optimal solution of the problem as indicated on the left side of the graph above.

The value of the basic variables keeps transforming to obtain the maximum value for the objective function. The optimal solution is found when all the coefficients in the objective row are non-negative. This means that the LP model clearly provides optimal performance that will lead to lasting output especially allocation of enough fund for better implementation of the activities towards achievement of planned targets.

4. CFC: Nakuru

Problem statement for feasible models for the AWP&B system optimization for county number four.

a) To produce 1,070,000 tree seedlings with a unit cost of Kshs 5.50 per tree seedling production.

b) To establish 527Ha of plantation with a unit cost of Kshs 22,194.00 per hectare of establishment.

c) To produce 2,500 bamboo seedlings with a unit cost of Kshs 9.00 per bamboo seedling production.

d) To rehabilitate and maintain 48Km of forest roads with a unit cost of Kshs 50,000.00 per kilometer of rehabilitation and maintenance.

e) To do a silvicultural treatment (Pruning) of 613Ha with a unit cost of Kshs 8,220.00 per hectare of silvicultural treatment.

f) To determine optimal solution of activities viable to be implemented in the county that minimizes the costs and increases the level of satisfaction of performance.

Table 4.23: LP model 4 optimization formulation and solution

Objective function	
The aim of the objective function is to maximize performance by implementing the five activities in the county while adhering to constraints of budget, raw materials cost, labour cost and machine operation cost due to limited fund allocation. The performance is in terms of the level of activities done.	
MaxZ:5,885,000X1+ 11,696,238X2+22,500X3+2,400,000X4+5,038,860X5 ≥ 17,603,738	
Where; Z is the objective function that should be maximized.	
X1, X2, X3, X4, X5 are decisions variables (The activities to be implemented) which are; Tree seedling production, Plantation establishment, Bamboo seedling production, Rehabilitation and maintenance of forest roads and Silvicultural treatment (Pruning) respectively.	
The coefficient of X1, X2, X3, X4, X5 are the unit cost of the decision's variables for the above activities.	
The objective function is subject to the following constraint equations:	
No	**Constraint equation**
1	Budget constraint: 5.5X1+22,194X2+9X3+50,000X4+8,220X5 ≤ 11,000,000
2	Raw materials cost constraint: 0.8X1+1.6X3 ≤ 860,000
3	Labour cost constraint: 22,194X2+8,220X5 ≤ 16,735,098
4	Machine operation cost constraint: 50,000X4 ≤ 2,400,000
5	Non-negativity constraint: X1, X2, X3, X4 and X5 ≥ 0

(Source: Author, 2025)

Table 4.23 above shows the results of LP model 4 optimization formulation and solution. It provides identified objective function with five (5) decision variables and ten (10)

constraints and explicitly states the non-negativity restriction used for writing down the optimization model.

Table 4.24: Results of LP model 4, solved using L&IP software

	14:32:34		Friday	June	07	2024		
	Decision Variable	Solution Value	Unit Cost or Profit c[j]	Total Contribution	Reduced Cost	Basis Status	Allowable Min. c[j]	Allowable Max. c[j]
1	X1	1.075.000,0000	5.885.000,0000	6.326.375.000.000,0000	0	basic	11.777,0000	M
2	X2	229,2286	11.696.240,0000	2.681.113.000,0000	0	basic	1.065.312,0000	13.604.920,0000
3	X3	0	22.500,0000	0	-11.746.450,0000	at bound	-M	11.768.950,0000
4	X4	0	2.400.000,0000	0	-23.950.000,0000	at bound	-M	26.350.000,0000
5	X5	0	5.038.860,0000	0	0	basic	4.331.940,0000	M
	Objective	Function	(Max.) =	6.329.056.000.000,0000				
	Constraint	Left Hand Side	Direction	Right Hand Side	Slack or Surplus	Shadow Price	Allowable Min. RHS	Allowable Max. RHS
1	C1	11.000.000,0000	<=	11.000.000,0000	0	527,0000	5.912.500,0000	22.647.600,0000
2	C2	860.000,0000	<=	860.000,0000	0	7.352.627,0000	0	1.600.000,0000
3	C3	5.087.500,0000	<=	16.735.100,0000	11.647.600,0000	0	5.087.500,0000	M
4	C4	0	<=	2.400.000,0000	2.400.000,0000	0	0	M
5	C5	1.075.000,0000	>=	0	1.075.000,0000	0	-M	1.075.000,0000
6	C6	229,2286	>=	0	229,2286	0	-M	229,2286
7	C7	0	>=	0	0	0	-M	0
8	C8	0	>=	0	0	0	-M	0
9	C9	0	<=	0	0	706.920,0000	0	618,9173
10	C10	0	<=	0	0	0	0	M

(Source: Author, 2025)

The results of L&IP are shown in table 4.24 above. According to the results, the solution value of decision variables X1 and X2 are Kshs 1,075,000.0000 and Kshs 229.2286 respectively. It means that it is viable to produce 1,070,000 seedlings and establish 527 Ha. The other variables X3, X4 and X5 are not economically viable based on the parameter value of the objective function and constraints. The results also show that the reduced cost of these activities X3 and X4, are Kshs -11,746,450.0000 and Kshs -23,950,000.0000 respectively. It means that if these values are added to the correspondent

parameter values on the objective function, these activities will be viable to be implemented. The shadow cost of the other constraint is zero. However, the one-unit changes of this constraints do not affect implementation of these activities. The slack variables introduced into the linear constraints of LP were identified as positive for candidate solution, and therefore the particular constraints were non-binding there in the model, as constraints do not restrict the possible changes from that point.

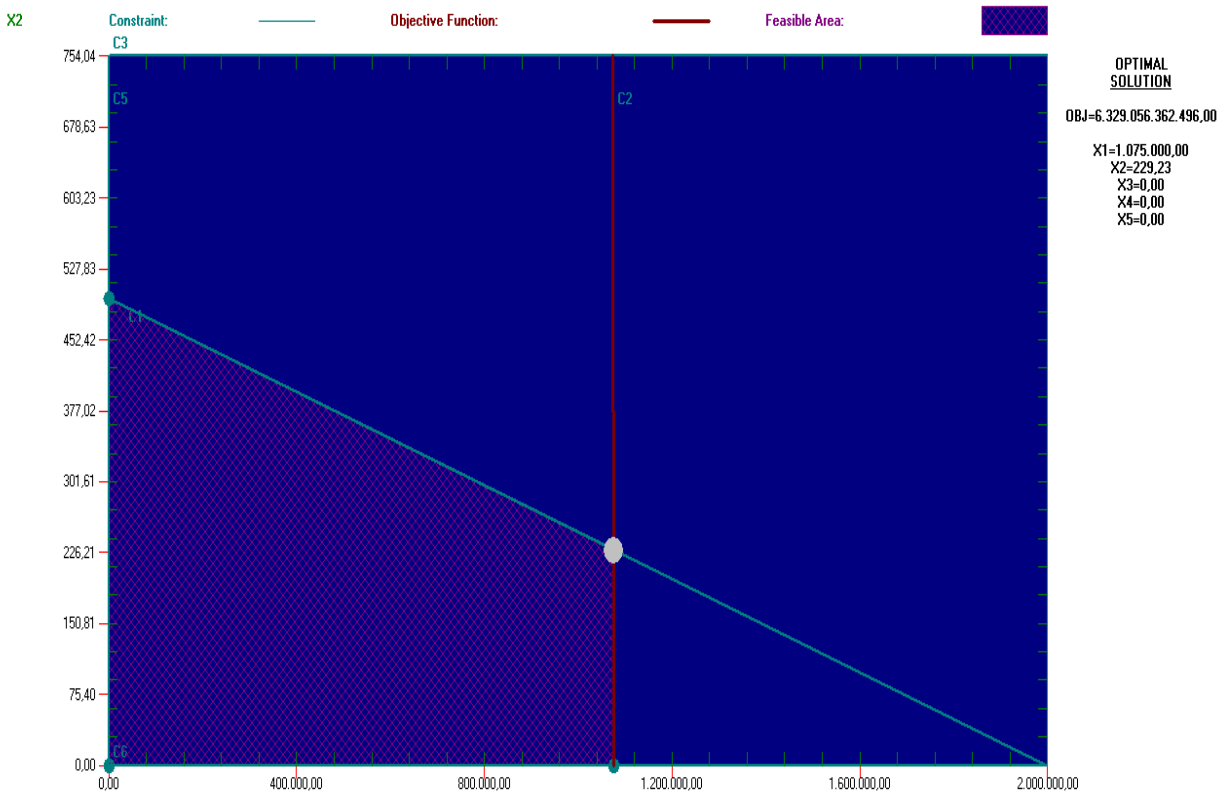

Figure 4.14: Graphical solution of LP model 4 showing feasible region

(Source: Author, 2025)

Figure 4.14 above of Graphical solution of LP model 4, the results show the visualized region shaded providing an optimal solution with objective function value of

maximization equals to Kshs 6,329,056,362,496.00 with X1 equals to Kshs 1,075,000.00 and X2 equals to Kshs 229.23.

The intersecting region in the graph reflects the decision feasible region as a result of plotting the inequalities in the XY graph. The feasible region provides the optimal solution as well as what all values the model takes in the optimization as shown in the figure 4.14 above. The feasible solution region on the graph is one which is satisfied by the constraints viewed as the intersection of valid region. The optimum point (**.**) at the intersection gives the values of the decision variables necessary to optimize the objective function after subjecting the values of the parameters into the equation of the objective function. This process results in proving the optimal solution of the problem as indicated on the left side of the graph above.

The value of the basic variables keeps transforming to obtain the maximum value for the objective function. The optimal solution is found when all the coefficients in the objective row are non-negative. This means that the LP model clearly provides optimal performance that will lead to lasting output especially allocation of enough fund for better implementation of the activities towards achievement of planned targets.

5. CFC: Baringo

Problem statement for feasible models for the AWP&B system optimization for county number five.

a) To produce 1,500,000 tree seedlings with a unit cost of Kshs 5.50 per tree seedling production.

b) To establish 200Ha of plantation with a unit cost of Kshs 22,194.00 per hectare of establishment.

c) To rehabilitate and maintain 57Km of forest roads with a unit cost of Kshs 50,000.00 per kilometer of rehabilitation and maintenance.

d) To do a silvicultural treatment (Pruning) of 100Ha with a unit cost of Kshs 8,220.00 per hectare of silvicultural treatment.

e) To determine optimal solution of activities viable to be implemented in the county that minimizes the costs and increases the level of satisfaction of performance.

Table 4.25: LP model 5 optimization formulation and solution

Objective function	
The aim of the objective function is to maximize performance by implementing the four activities in the county while adhering to constraints of budget, raw materials cost, labour cost and machine operation cost due to limited fund allocation. The performance is in terms of the level of activities done.	
MaxZ:8,250,000X1+ 4,438,800X2+2,850,000X3+822,000X4 ≥ 16,360,800	
Where; Z is the objective function that should be maximized.	
X1, X2, X3, X4 are decisions variables (The activities to be implemented) which are; Tree seedling production, Plantation establishment, Rehabilitation and maintenance of forest roads and Silvicultural treatment (Pruning) respectively.	
The coefficient of X1, X2, X3, X4 are the unit cost of the decision's variables for the above activities.	
The objective function is subject to the following constraint equations:	
No	**Constraint equation**
1	Budget constraint: 5.5X1+22,194X2+50,000X3+8,220X4 ≤ 11,000,000
2	Raw materials cost constraint: 0.8X1 ≤ 1,200,000
3	Labour cost constraint: 22,194X2+8,220X4 ≤ 5,260,800
4	Machine operation cost constraint: 50,000X3 ≤ 2,850,000
5	Non-negativity constraint: X1, X2, X3 and X4 ≥ 0

(Source: Author, 2025)

Table 4.25 above shows the results of LP model 5 optimization formulation and solution. It provides identified objective function with four (4) decision variables and nine (9) constraints and explicitly states the non-negativity restriction used for writing down the optimization model.

Table 4.26: Results of LP model 5, solved using L&IP software

	14:58:53		Friday	June	07	2024		
	Decision Variable	Solution Value	Unit Cost or Profit c[j]	Total Contribution	Reduced Cost	Basis Status	Allowable Min. c[j]	Allowable Max. c[j]
1	X1	1.200.000,0000	8.250.000,0000	9.900.000.000.000,0000	0	basic	1.100,0000	M
2	X2	198,2518	4.438.800,0000	880.000.000,0000	0	basic	2.219.400,0000	33.291.000.000,0000
3	X3	0	2.850.000,0000	0	-7.150.000,0000	at bound	-M	10.000.000,0000
4	X4	0	822.000,0000	0	-822.000,0000	at bound	-M	1.644.000,0000
	Objective	Function	(Max.) =	9.900.880.000.000,0000				
	Constraint	Left Hand Side	Direction	Right Hand Side	Slack or Surplus	Shadow Price	Allowable Min. RHS	Allowable Max. RHS
1	C1	11.000.000,0000	<=	11.000.000,0000	0	200,0000	6.600.000,0000	11.860.800,0000
2	C2	1.200.000,0000	<=	1.200.000,0000	0	8.248.900,0000	1.043.491,0000	2.000.000,0000
3	C3	4.400.000,0000	<=	5.260.800,0000	860.800,0000	0	4.400.000,0000	M
4	C4	0	<=	2.850.000,0000	2.850.000,0000	0	0	M
5	C5	1.200.000,0000	>=	0	1.200.000,0000	0	-M	1.200.000,0000
6	C6	198,2518	>=	0	198,2518	0	-M	198,2518
7	C7	0	>=	0	0	0	-M	0
8	C8	0	>=	0	0	0	-M	0
9	C9	0	<=	0	0	0	0	M

(Source: Author, 2025)

The results of L&IP are shown in table 4.26 above. According to the results, the solution value of decision variables X1 and X2 are Kshs 1,200,000.0000 and Kshs 198.2518 respectively. It means that it is viable to produce 1,500,000 of tree seedlings and establish

200 Ha of plantation in the county. The other variables X3 and X4 are not economically viable based on the parameter value of the objective function and constraints. The results also show that the reduced cost of these activities X3 and X4 are Kshs -7,150,000.0000 and Kshs -822,000.0000 respectively. It means that if these values are added to the correspondent parameter values on the objective function, these activities will be viable to be implemented. The shadow cost of the other constraints is zero. However, the one-unit changes of this constraints do not affect implementation of these activities. The slack variables introduced into the linear constraints of LP were identified as positive for candidate solution, and therefore the particular constraints were non-binding there in the model, as constraints do not restrict the possible changes from that point.

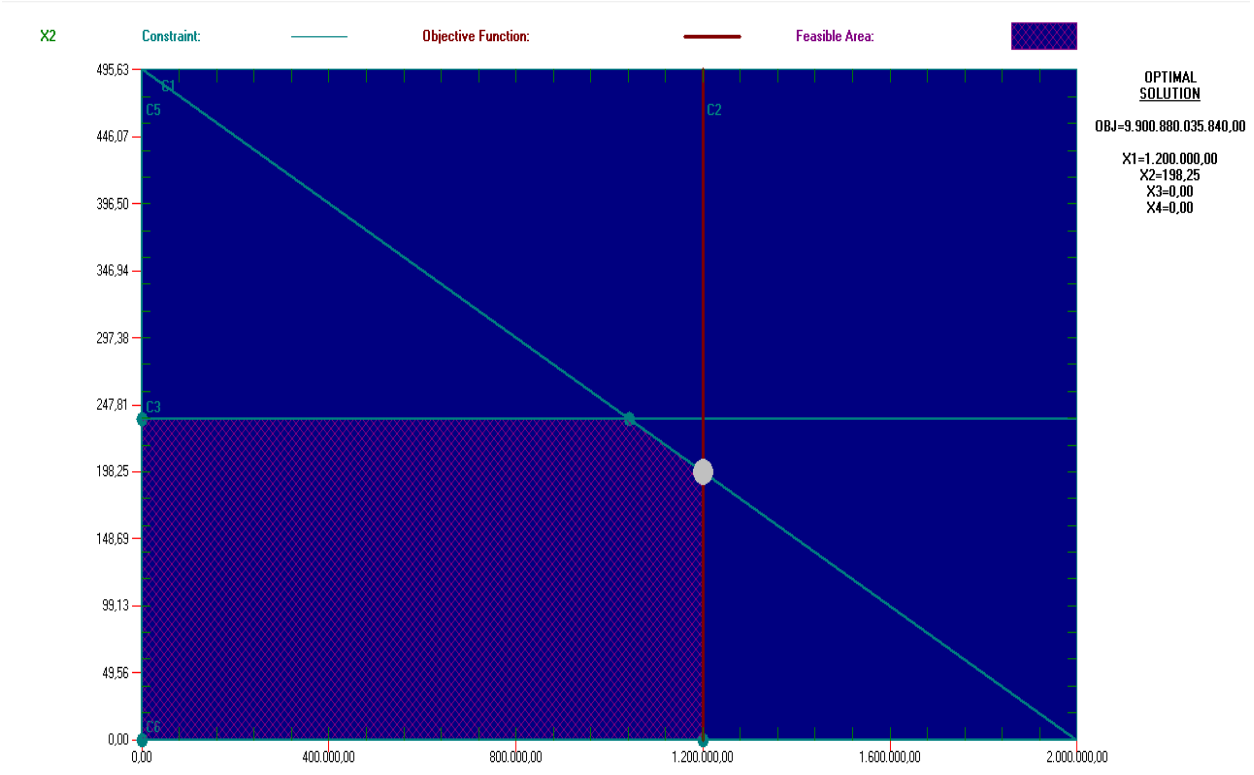

Figure 4.15: Graphical solution of LP model 5 showing feasible region

(Source: Author, 2025)

Figure 4.15 above of Graphical solution of LP model 5, the results show the visualized region shaded providing an optimal solution with objective function value of maximization equals to Kshs 9,900,800,035.00 with X1 equals to Kshs 1,200,000.00 and X2 equals to Kshs 198.25, X3 equals to 0.00 and X4 equals to 0.00.

The intersecting region in the graph reflects the decision feasible region as a result of plotting the inequalities in the XY graph. The feasible region provides the optimal solution as well as what all values the model takes in the optimization as shown in the figure 4.15 above. The feasible solution region on the graph is one which is satisfied by the constraints viewed as the intersection of valid region. The optimum point (**.**) at the intersection gives the values of the decision variables necessary to optimize the objective function after subjecting the values of the parameters into the equation of the objective function. This process results in proving the optimal solution of the problem as indicated on the left side of the graph above.

The value of the basic variables keeps transforming to obtain the maximum value for the objective function. The optimal solution is found when all the coefficients in the objective row are non-negative. This means that the LP model clearly provides optimal performance that will lead to lasting output especially allocation of enough fund for better implementation of the activities towards achievement of planned targets.

6. CFC: Nyeri

Problem statement for feasible models for the AWP&B system optimization for county number six.

a) To produce 1,500,000 tree seedlings with a unit cost of Kshs 5.50 per tree seedling production.

b) To establish 240Ha of plantation with a unit cost of Kshs 22,194.00 per hectare of establishment.

c) To rehabilitate and maintain 74Km of forest roads with a unit cost of Kshs 50,000.00 per kilometer of rehabilitation and maintenance.

d) To do a silvicultural treatment (Pruning) of 200Ha with a unit cost of Kshs 8,220.00 per hectare of silvicultural treatment.

e) To determine optimal solution of activities viable to be implemented in the county that minimizes the costs and increases the level of satisfaction of performance.

Table 4.27: LP model 6 optimization formulation and solution

Objective function	
The aim of the objective function is to maximize performance by implementing the four activities in the county while adhering to constraints of budget, raw materials cost, labour cost and machine operation cost due to limited fund allocation. The performance is in terms of the level of activities done.	
MaxZ:8,250,000X1+ 5,326,560X2+3,700,000X3+1,644,000X4 ≥ 18,920,560	
Where; Z is the objective function that should be maximized.	
X1, X2, X3, X4 are decisions variables (The activities to be implemented) which are; Tree seedling production, Plantation establishment, Rehabilitation and maintenance of forest roads and Silvicultural treatment (Pruning) respectively.	
The coefficient of X1, X2, X3, X4 are the unit cost of the decision's variables for the above activities.	
The objective function is subject to the following constraint equations:	
No	**Constraint equation**
1	Budget constraint: 5.5X1+22,194X2+50,000X3+8,220X4 ≤ 14,000,000
2	Raw materials cost constraint: 0.8X1 ≤ 1,200,000
3	Labour cost constraint: 22,194X2+8,220X4 ≤ 6,970,560
4	Machine operation cost constraint: 50,000X3 ≤ 3,700,000
5	Non-negativity constraint: X1, X2, X3 and X4 ≥ 0

(Source: Author, 2025)

Table 4.27 above shows the results of LP model 6 optimization formulation and solution. It provides identified objective function with four (4) decision variables and eight (8) constraints and explicitly states the non-negativity restriction used for writing down the optimization model.

Table 4.28: Results of LP model 6, solved using L&IP software

	15:24:58		Friday	June	07	2024		
	Decision Variable	Solution Value	Unit Cost or Profit c(j)	Total Contribution	Reduced Cost	Basis Status	Allowable Min. c(j)	Allowable Max. c(j)
1	X1	1.200.000,0000	8.250.000,0000	9.900.000.000.000,0000	0	basic	407,0000	M
2	X2	314,0741	5.326.560,0000	1.672.934.000,0000	0	basic	4.438.800,0000	M
3	X3	8,5888	3.700.000,0000	31.778.560,0000	0	basic	0	12.000.000,0000
4	X4	0	1.644.000,0000	0	-328.800,0000	at bound	-M	1.972.800,0000
	Objective	Function	(Max.) =	9.901.704.000.000,0000				
	Constraint	Left Hand Side	Direction	Right Hand Side	Slack or Surplus	Shadow Price	Allowable Min. RHS	Allowable Max. RHS
1	C1	14.000.000,0000	<=	14.000.000,0000	0	74,0000	13.570.560,0000	185.013.600.000,0000
2	C2	1.200.000,0000	<=	1.200.000,0000	0	8.249.593,0000	0	1.278.080,0000
3	C3	6.970.560,0000	<=	6.970.560,0000	0	166,0000	0	7.400.000,0000
4	C4	8,5888	<=	3.700.000,0000	3.699.992,0000	0	8,5000	M
5	C5	1.200.000,0000	>=	0	1.200.000,0000	0	-M	1.200.000,0000
6	C6	314,0741	>=	0	314,0741	0	-M	314,0741
7	C7	8,5888	>=	0	8,5888	0	-M	8,5888
8	C8	0	<=	0	0	0	0	M

(Source: Author, 2025)

The results of L&IP are shown in table 4.28 above. According to the results, the solution value of decision variables X1, X2 and X4 are Kshs 1,200,000.0000, Kshs 314.0741 and Kshs 8.5888 respectively. It means that it is viable to produce 1,500,000 tree seedlings, establish 240 Ha of plantation and rehabilitate and maintain 74 Km of forest roads. The

other variable X4 is not economically viable based on the parameter value of the objective function and constraints. The results also show that the reduced cost of these activity X4 is Kshs -328,800.0000. It means that if these values are added to the correspondent parameter values on the objective function, these activities will be viable to be implemented. The shadow cost of the other constraints is zero. However, the one-unit changes of this constraints do not affect implementation of these activities. The slack variables introduced into the linear constraints of LP were identified as positive for candidate solution, and therefore the particular constraints were non-binding there in the model, as constraints do not restrict the possible changes from that point.

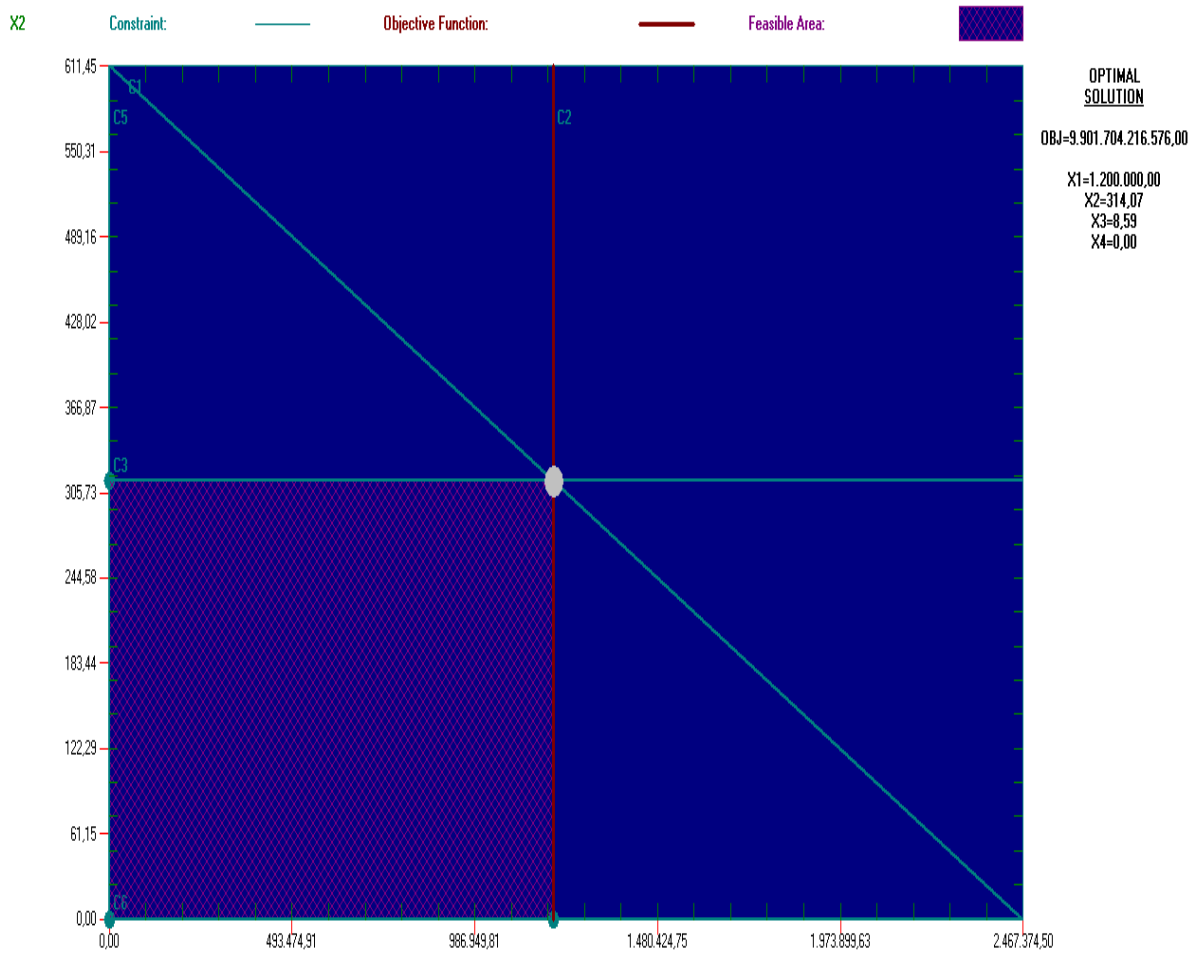

Figure 4.16: Graphical solution of LP model 6 showing feasible region

(Source: Author, 2025)

Figure 4.18 above of Graphical solution of LP model 6, the results show the visualized region shaded providing an optimal solution with objective function value of maximization equals to Kshs 9,901,704,216,576.00 with X1 equals to Kshs 1,200,000.00, X2 equals to Kshs 312.07, X3 equals to Kshs 8.59 and X4 equals to Kshs 0.00.

The intersecting region in the graph reflects the decision feasible region as a result of plotting the inequalities in the XY graph. The feasible region provides the optimal solution as well as what all values the model takes in the optimization as shown in the

figure 4.16 above. The feasible solution region on the graph is one which is satisfied by the constraints viewed as the intersection of valid region. The optimum point (**.**) at the intersection gives the values of the decision variables necessary to optimize the objective function after subjecting the values of the parameters into the equation of the objective function. This process results in proving the optimal solution of the problem as indicated on the left side of the graph above.

The value of the basic variables keeps transforming to obtain the maximum value for the objective function. The optimal solution is found when all the coefficients in the objective row are non-negative. This means that the LP model clearly provides optimal performance that will lead to lasting output especially allocation of enough fund for better implementation of the activities towards achievement of planned targets.

7. CFC: Taita Taveta

Problem statement for feasible models for the AWP&B system optimization for county number seven.

a) To produce 313,000 tree seedlings with a unit cost of Kshs 5.50 per tree seedling production.

b) To produce 550 bamboo seedlings with a unit cost of Kshs 9.00 per bamboo seedling production.

c) To determine optimal solution of activities viable to be implemented in the county that minimizes the costs and increases the level of satisfaction of performance.

Table 4.29: LP 7 model optimization formulation and solution

Objective function	
The aim of the objective function is to maximize performance by implementing the two activities in the county while adhering to constraints of budget, raw materials cost and labour cost due to limited fund allocation. The performance is in terms of the level of activities done.	
MaxZ:1,721,500X1+ 4,950X2 ≥ 1,726,450	
Where; Z is the objective function that should be maximized.	
X1, X2 are decisions variables (The activities to be implemented) which are; Tree seedling production and Bamboo seedling production respectively.	
The coefficient of X1, X2 are the unit cost of the decision's variables for the above activities.	
The objective function is subject to the following constraint equations:	
No	**Constraint equation**
1	Budget constraint: 5.5X1+9X2 ≤ 700,000
2	Raw materials cost constraint: 0.8X1 +1.6X2 ≤ 251,280
4	Non-negativity constraint: X1and X2 ≥ 0

(Source: Author, 2025)

Table 4.29 above shows the results of LP model 7 optimization formulation and solution. It provides identified objective function with two (2) decision variables and eleven (4)

constraints and explicitly states the non-negativity restriction used for writing down the optimization model.

Table 4.30: Results of LP model 7, solved using L&IP software

	15:36:45		Friday	June	07	2024		
	Decision Variable	Solution Value	Unit Cost or Profit c(j)	Total Contribution	Reduced Cost	Basis Status	Allowable Min. c(j)	Allowable Max. c(j)
1	X1	127.272,7000	1.721.500,0000	219.100.000.000,0000	0	basic	3.025,0000	M
2	X2	0	4.950,0000	0	-2.812.050,0000	at bound	-M	2.817.000,0000
	Objective	Function	(Max.) =	219.100.000.000,0000				
	Constraint	Left Hand Side	Direction	Right Hand Side	Slack or Surplus	Shadow Price	Allowable Min. RHS	Allowable Max. RHS
1	C1	700.000,0000	<=	700.000,0000	0	313.000,0000	0	1.727.550,0000
2	C2	101.818,2000	<=	251.280,0000	149.461,8000	0	101.818,2000	M
3	C3	127.272,7000	>=	0	127.272,7000	0	-M	127.272,7000
4	C4	0	>=	0	0	0	-M	0

(Source: Author, 2025)

The results of L&IP are shown in table 4.30 above. According to the results, the solution value of decision variables X1 is Kshs 127,272.7000. It means that it is viable to produce 313,000 of tree seedlings. The other variable X2 is not economically viable based on the parameter value of the objective function and constraints. The results also show that the reduced cost of this activity X2 is Kshs -2,812,050.0000. It means that if these values are added to the correspondent parameter values on the objective function, these activities

will be viable to be implemented. The shadow cost of the other constraints is zero. However, the one-unit changes of this constraints do not affect implementation of these activities. The slack variables introduced into the linear constraints of LP were identified as positive for candidate solution, and therefore the particular constraints were non-binding there in the model, as constraints do not restrict the possible changes from that point.

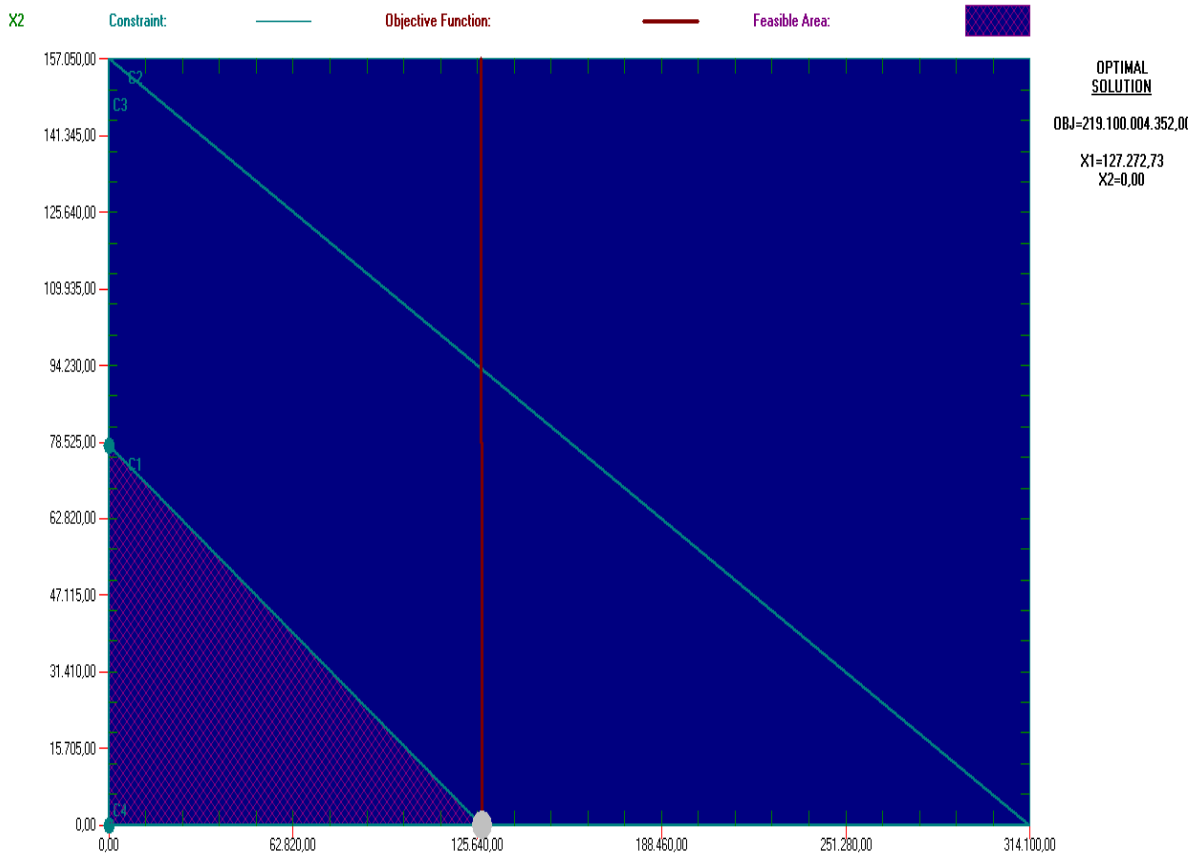

Figure 4.17: Graphical solution of LP 7 model showing feasible region

(Source: Author, 2025)

Figure 4.17 above of Graphical solution of LP model 7, the results show the visualized region shaded providing an optimal solution with objective function value of maximization equals to Kshs 219,100,004,352.00 with X1 equals to Kshs 127,272.73 and X2 equals to Kshs 0.00.

The intersecting region in the graph reflects the decision feasible region as a result of plotting the inequalities in the XY graph. The feasible region provides the optimal solution as well as what all values the model takes in the optimization as shown in the figure 4.17 above. The feasible solution region on the graph is one which is satisfied by the constraints viewed as the intersection of valid region. The optimum point (**.**) at the intersection gives the values of the decision variables necessary to optimize the objective function after subjecting the values of the parameters into the equation of the objective function. This process results in proving the optimal solution of the problem as indicated on the left side of the graph above.

The value of the basic variables keeps transforming to obtain the maximum value for the objective function. The optimal solution is found when all the coefficients in the objective row are non-negative. This means that the LP model clearly provides optimal performance that will lead to lasting output especially allocation of enough fund for better implementation of the activities towards achievement of planned targets.

8. CFC: Kwale

Problem statement for feasible models for the AWP&B system optimization for county number eight.

a) To produce 1,500,000 tree seedlings with a unit cost of Kshs 5.50 per tree seedling production.

b) To establish 50Ha of plantation with a unit cost of Kshs 22,194.00 per hectare of establishment.

c) To rehabilitate 200Ha of natural forests with a unit cost of Kshs 22,194.00 per hectare of rehabilitation.

d) To produce 2,000 bamboo seedlings with a unit cost of Kshs 9.00 per bamboo seedling production.

e) To rehabilitate and maintain 40Km of forest roads with a unit cost of Kshs 50,000.00 per kilometer of rehabilitation and maintenance.

f) To determine optimal solution of activities viable to be implemented in the county that minimizes the costs and increases the level of satisfaction of performance.

Table 4.31: LP model 8 optimization formulation and solution

Objective function	
The aim of the objective function is to maximize performance by implementing the five activities in the county while adhering to constraints of budget, raw materials cost, labour cost and machine operation cost due to limited fund allocation. The performance is in terms of the level of activities done.	
MaxZ:8,250,000X1+ 1,109,700X2+4,438,800X3+18,000X4+2,000,000X5 ≥ 15,816,500	
Where; Z is the objective function that should be maximized.	
X1, X2, X3, X4, X5 are decisions variables (The activities to be implemented) which are; Tree seedling production, Plantation establishment, Natural Forest rehabilitation, Bamboo seedling production and Rehabilitation and maintenance of forest roads respectively	
The coefficient of X1, X2, X3, X4, X5 are the unit cost of the decision's variables for the above activities.	
The objective function is subject to the following constraint equations:	
No	**Constraint equation**
1	Budget constraint: 5.5X1+22,194X2+22,194X3+9X4+50,000X5 ≤ 14,000,000
2	Raw materials cost constraint: 0.8X1+1.6X4 ≤ 1,203,200
3	Labour cost constraint: 22,194X2+22,194X3 ≤ 5,548,500
4	Machine operation cost constraint: 50,000X5 ≤ 2,000,000
5	Non-negativity constraint: X1, X2, X3, X4 and X5 ≥ 0

(Source: Author, 2025)

Table 4.31 above shows the results of LP model 8 optimization formulation and solution. It provides identified objective function with five (5) decision variables and nine (9)

constraints and explicitly states the non-negativity restriction used for writing down the optimization model.

Table 4.32: Results of LP model 8, solved using L&IP software

	15:49:17		Friday	June	07	2024		
	Decision Variable	Solution Value	Unit Cost or Profit c[j]	Total Contribution	Reduced Cost	Basis Status	Allowable Min. c[j]	Allowable Max. c[j]
1	X1	1.504.000,0000	8.250.000,0000	12.408.000.000.000,0000	0	basic	9.040,0000	M
2	X2	0	1.109.700,0000	0	-3.329.100,0000	at bound	-M	4.438.800,0000
3	X3	250,0000	4.438.800,0000	1.109.700.000,0000	0	basic	1.109.700,0000	M
4	X4	0	18.000,0000	0	-16.481.920,0000	at bound	-M	16.499.920,0000
5	X5	3,5900	2.000.000,0000	7.180.005,0000	0	basic	0	10.000.000,0000
	Objective	Function	(Max.) =	12.409.120.000.000,0000				
	Constraint	Left Hand Side	Direction	Right Hand Side	Slack or Surplus	Shadow Price	Allowable Min. RHS	Allowable Max. RHS
1	C1	14.000.000,0000	<=	14.000.000,0000	0	40,0000	13.820.500,0000	100.013.800.000,0000
2	C2	1.203.200,0000	<=	1.203.200,0000	0	10.312.230,0000	0	1.229.309,0000
3	C3	5.548.500,0000	<=	5.548.500,0000	0	160,0000	0	5.728.000,0000
4	C4	3,5900	<=	2.000.000,0000	1.999.996,0000	0	3,6250	M
5	C5	1.504.000,0000	>=	0	1.504.000,0000	0	-M	1.504.000,0000
6	C6	0	>=	0	0	0	-M	0
7	C7	250,0000	>=	0	250,0000	0	-M	250,0000
8	C8	0	>=	0	0	0	-M	0
9	C9	3,5900	>=	0	3,5900	0	-M	3,5900

(Source: Author, 2025)

The results of L&IP are shown in table 4.32 above. According to the results, the value of decision variables X1, X3 and X5 are Kshs 1,504,000.0000, Kshs 250.0000 and Kshs 3.5900 respectively. It means that it is viable to produce 1,500,000 of tree seedlings, establish 200Ha of natural forests and rehabilitate and maintain 40Km of forest roads. The other variables X2 and X4 are not economically viable based on the parameter value of the objective function and constraints. The results also show that the reduced cost of

these activities X2 and X4 are Kshs -3,329,100.0000 and Kshs -16,481,920.0000 respectively. It means that if these values are added to the correspondent parameter values on the objective function, these activities will be viable to be implemented. The shadow cost of the other constraints is zero. However, the one-unit changes of this constraints do not affect implementation of these activities. The slack variables introduced into the linear constraints of LP were identified as positive for candidate solution, and therefore the particular constraints were non-binding there in the model, as constraints do not restrict the possible changes from that point.

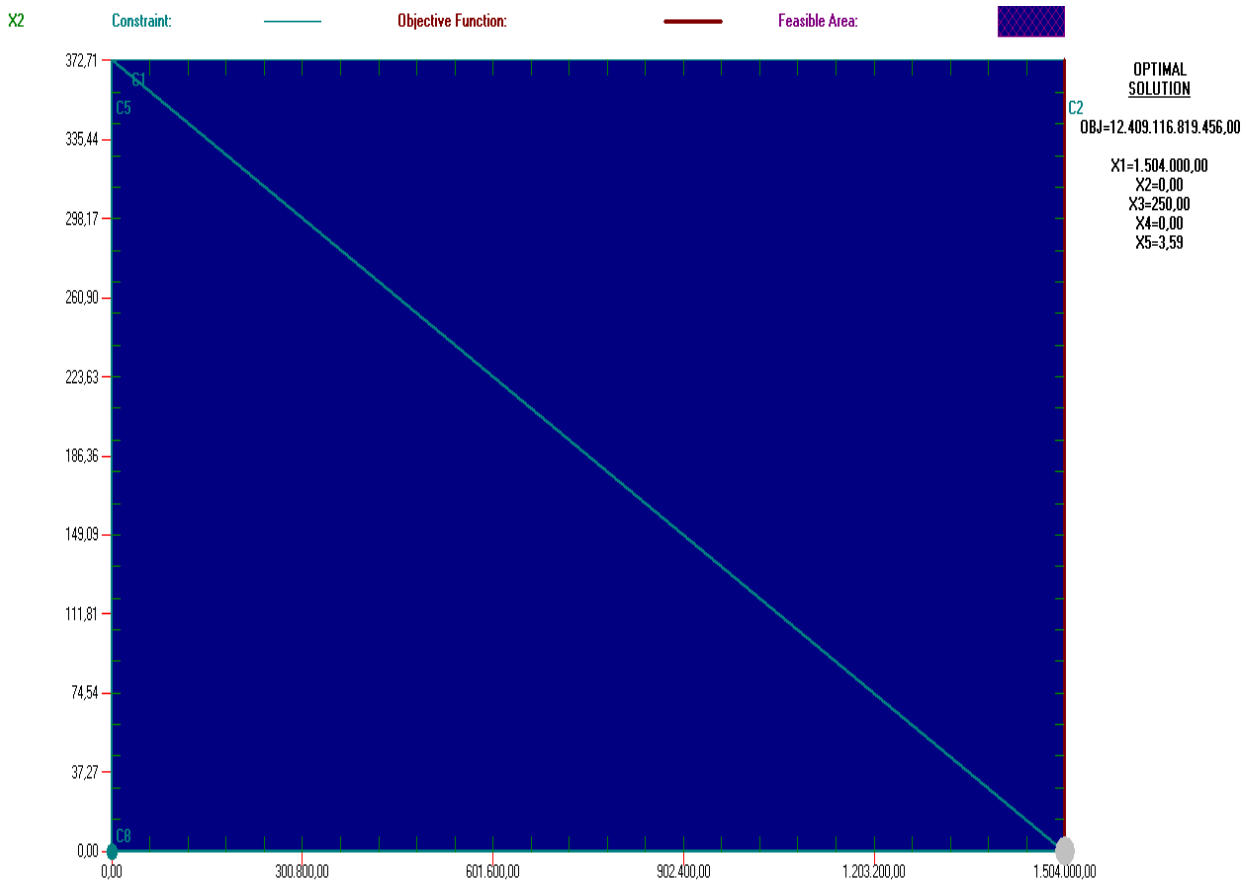

Figure 4.18: Graphical solution of LP model 8 showing feasible region

(Source: Author, 2025)

Figure 4.18 above of Graphical solution of LP model 8, the results show the visualized region shaded providing an optimal solution with objective function value of maximization equals to Kshs 12,409,116,819,456.00 with X1 equals to Kshs 1,504,000.00, X2 equals to Kshs 0.00, X3 equals to Kshs 250.00, X4 equals to Kshs 0.00 and X5 equals to Kshs 3.59.

The intersecting region in the graph reflects the decision feasible region as a result of plotting the inequalities in the XY graph. The feasible region provides the optimal solution as well as what all values the model takes in the optimization as shown in the figure 4.18 above. The feasible solution region on the graph is one which is satisfied by the constraints viewed as the intersection of valid region. The optimum point (**.**) at the intersection gives the values of the decision variables necessary to optimize the objective function after subjecting the values of the parameters into the equation of the objective function. This process results in proving the optimal solution of the problem as indicated on the left side of the graph above.

The value of the basic variables keeps transforming to obtain the maximum value for the objective function. The optimal solution is found when all the coefficients in the objective row are non-negative. This means that the LP model clearly provides optimal performance that will lead to lasting output especially allocation of enough fund for better implementation of the activities towards achievement of planned targets.

9. CFC: Embu

Problem statement for feasible models for the AWP&B system optimization for county number nine.

a) To produce 2,000,000 tree seedlings with a unit cost of Kshs 5.50 per tree seedling production.

b) To establish 80Ha of plantation with a unit cost of Kshs 22,194.00 per hectare of establishment.

c) To establish 500Ha of commercial farm forests with a unit cost of Kshs 14,400.00 per hectare of establishment.

d) To produce 1,600 bamboo seedlings with a unit cost of Kshs 9.00 per bamboo seedling production.

e) To rehabilitate and maintain 55Km of forest roads with a unit cost of Kshs 50,000.00 per kilometer of rehabilitation and maintenance.

f) To do a silvicultural treatment (Pruning) of 90Ha with a unit cost of Kshs 8,220.00 per hectare of silvicultural treatment.

g) To determine optimal solution of activities viable to be implemented in the county that minimizes the costs and increases the level of satisfaction of performance.

Table 4.33: LP model 9 optimization formulation and solution

Objective function	
The aim of the objective function is to maximize performance by implementing the six activities in the county while adhering to constraints of budget, raw materials cost, labour cost and machine operation cost due to limited fund allocation. The performance is in terms of the level of activities done.	
MaxZ:11,000,000X1+ 1,775,520X2+7,200,000X3+14,400X4+2,750,000X5 +739,800X6 ≥ 22,739,920	
Where; Z is the objective function that should be maximized.	
X1, X2, X3, X4, X5, X6 are decisions variables (The activities to be implemented) which are; Tree seedling production, Plantation establishment, Commercial farm forest establishment, Bamboo seedling production, Rehabilitation and maintenance of forest roads and Silvicultural treatment (Pruning) respectively.	
The coefficient of X1, X2, X3, X4, X5, X6 are the unit cost of the decision's variables for the above activities.	
The objective function is subject to the following constraint equations:	
No	**Constraint equation**
1	Budget constraint: 5.5X1+22,194X2+14,400X3+9X4+50,000X5+8,220X6 ≤ 21,000,000
2	Raw materials cost constraint: 0.8X1+1.6X4 ≤ 1,602,560
3	Labour cost constraint: 22,194X2+14,400X3+8,220X6 ≤ 9,715,320
4	Machine operation cost constraint: 50,000X5 ≤ 2,750,000
5	Non-negativity constraint: X_1, X_2, X_3, X_4, X_5 and $X_6 \geq 0$

(Source: Author, 2025)

Table 4.33 above shows the results of LP model 9 optimization formulation and solution. It provides identified objective function with seven (6) decision variables and eleven (10) constraints and explicitly states the non-negativity restriction used for writing down the optimization model.

Table 4.34: Results of LP model 9, solved using L&IP software

	16:01:08		Friday	June	07	2024		
	Decision Variable	Solution Value	Unit Cost or Profit c[j]	Total Contribution	Reduced Cost	Basis Status	Allowable Min. c[j]	Allowable Max. c[j]
1	X1	2.003.200,0000	11.000.000,0000	22.035.200.000.000,0000	0	basic	7.255,0000	M
2	X2	0	1.775.520,0000	0	-9.321.480,0000	at bound	-M	11.097.000,0000
3	X3	674,6750	7.200.000,0000	4.857.660.000,0000	0	basic	1.296.000,0000	M
4	X4	0	14.400,0000	0	-21.985.490,0000	at bound	-M	21.999.890,0000
5	X5	5,3416	2.750.000,0000	14.689.410,0000	0	basic	0	25.000.000,0000
6	X6	0	739.800,0000	0	-3.370.200,0000	at bound	-M	4.110.000,0000
	Objective	Function	(Max.) =	22.040.070.000.000,0000				
	Constraint	Left Hand Side	Direction	Right Hand Side	Slack or Surplus	Shadow Price	Allowable Min. RHS	Allowable Max. RHS
1	C1	21.000.000,0000	<=	21.000.000,0000	0	55,0000	20.732.920,0000	137.520.700.000,0000
2	C2	1.602.560,0000	<=	1.602.560,0000	0	13.749.620,0000	0	1.641.408,0000
3	C3	9.715.320,0000	<=	9.715.320,0000	0	445,0000	0	9.982.400,0000
4	C4	5,3416	<=	2.750.000,0000	2.749.995,0000	0	5,2500	M
5	C5	2.003.200,0000	>=	0	2.003.200,0000	0	-M	2.003.200,0000
6	C6	0	>=	0	0	0	-M	0
7	C7	674,6750	>=	0	674,6750	0	-M	674,6750
8	C8	0	>=	0	0	0	-M	0
9	C9	5,3416	>=	0	5,3416	0	-M	5,3416
10	C10	0	>=	0	0	0	-M	0

(Source: Author, 2025)

The results of L&IP are shown in table 4.34 above. According to the results, the value of decision variables X1, X3 and X5 are Kshs 2,003,200.0000, Kshs 674.6750 and Kshs 5.3416 respectively. It means that it is viable to produce 2,000,000 of seedlings, establish 500Ha of commercial farm forests and rehabilitate and maintain 55Km of forest roads.

The other variables X2, X4 and X6 are not economically viable based on the parameter value of the objective function and constraints. The results also show that the reduced cost of these activities X2, X4 and X6 are Kshs -9,321,480.00, Kshs -21,985,490.00 and Kshs -3,370,200.00 respectively. It means that if these values are added to the correspondent parameter values on the objective function, these activities will be viable to be implemented. The shadow cost of the other constraints is zero. However, the one-unit changes of this constraints do not affect implementation of these activities. The slack variables introduced into the linear constraints of LP were identified as positive for candidate solution, and therefore the particular constraints were non-binding there in the model, as constraints do not restrict the possible changes from that point.

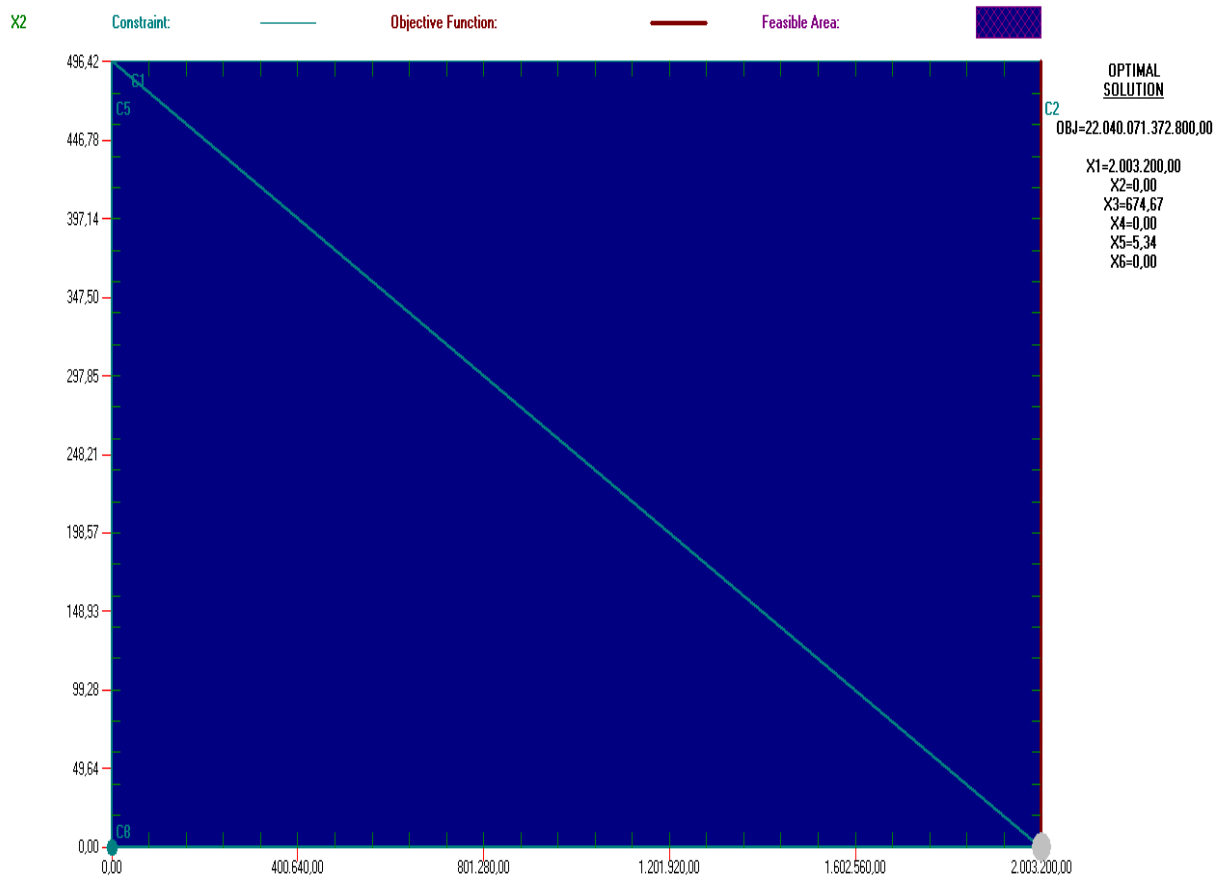

Figure 4.19: Graphical solution of LP model 9 showing feasible region

(Source: Author, 2025)

Figure 4.19 above of Graphical solution of LP model 9, the results show the visualized region shaded providing an optimal solution with objective function value of maximization equals to Kshs 22,040,071,372,800.00 with X1 equals to Kshs 2,003,200.00, X2 equals to Kshs 0.00, X3 equals to Kshs 674.67, X4 equals to Kshs 0.00, X5 equals to Kshs 5.34 and X6 equals to Kshs 0.00.

The intersecting region in the graph reflects the decision feasible region as a result of plotting the inequalities in the XY graph. The feasible region provides the optimal solution as well as what all values the model takes in the optimization as shown in the figure 4.19 above. The feasible solution region on the graph is one which is satisfied by the constraints viewed as the intersection of valid region. The optimum point (**.**) at the intersection gives the values of the decision variables necessary to optimize the objective function after subjecting the values of the parameters into the equation of the objective function. This process results in proving the optimal solution of the problem as indicated on the left side of the graph above.

The value of the basic variables keeps transforming to obtain the maximum value for the objective function. The optimal solution is found when all the coefficients in the objective row are non-negative. This means that the LP model clearly provides optimal performance that will lead to lasting output especially allocation of enough fund for better implementation of the activities towards achievement of planned targets.

10. CFC: Kirinyaga

Problem statement for feasible models for the AWP&B system optimization for county number ten.

a) To produce 1,500,000 tree seedlings with a unit cost of Kshs 5.50 per tree seedling production.

b) To establish 31Ha of plantation with a unit cost of Kshs 22,194.00 per hectare of establishment.

c) To rehabilitate 130Ha of natural forests with a unit cost of Kshs 22,194.00 per hectare of rehabilitation.

d) To establish 500Ha of commercial farm forests with a unit cost of Kshs 14,400.00 per hectare of establishment.

e) To produce 1,530 bamboo seedlings with a unit cost of Kshs 9.00 per bamboo seedling production.

f) To rehabilitate and maintain 52Km of forest roads with a unit cost of Kshs 50,000.00 per kilometer of rehabilitation and maintenance.

g) To do a silvicultural treatment (Pruning) of 700Ha with a unit cost of Kshs 8,220.00 per hectare of silvicultural treatment.

h) To determine optimal solution of activities viable to be implemented in the county that minimizes the costs and increases the level of satisfaction of performance.

Table 4.35: LP model 10 optimization formulation and solution

Objective function	
The aim of the objective function is to maximize performance by implementing the seven activities in the county while adhering to constraints of budget, raw materials cost, labour cost and machine operation cost due to limited fund allocation. The performance is in terms of the level of activities done.	
MaxZ:8,250,000X1+ 688,014X2+2,885,220X3+7,200,000X4+13,770X5 +2,600,000X6+ 5,754,000X7 ≥ 27,391,004	
Where; Z is the objective function that should be maximized.	
X1, X2, X3, X4, X5, X6, X7 are decisions variables (The activities to be implemented) which are; Tree seedling production, Plantation establishment, Natural Forest rehabilitation, Commercial farm forest establishment, Bamboo seedling production, Rehabilitation and maintenance of forest roads and Silvicultural treatment (Pruning) respectively.	
The coefficient of X1, X2, X3, X4, X5, X6, X7 are the unit cost of the decision's variables for the above activities.	
The objective function is subject to the following constraint equations:	
No	**Constraint equation**
1	Budget constraint: 5.5X1+22,194X2+22,194X3+14,400X4+9X5+50,000X6+8,220X7 ≤ 25,000,000
2	Raw materials cost constraint: 0.8X1+1.6X5 ≤ 1,202,448
3	Labour cost constraint: 22,194X2+22,194X3+14,400X4+8,220X7 ≤ 16,527,234
4	Machine operation cost constraint: 50,000X6 ≤ 2,600,000
5	Non-negativity constraint: X1, X2, X3, X4, X5, X6 and X7 ≥ 0

(Source: Author, 2025)

Table 4.35 above shows the results of LP model 10 optimization formulation and solution. It provides identified objective function with seven (7) decision variables and eleven (11) constraints and explicitly states the non-negativity restriction used for writing down the optimization model.

Table 4.36: Results of LP model 10, solved using L&IP software

	16:18:22		Friday	June	07	2024		
	Decision Variable	Solution Value	Unit Cost or Profit c(j)	Total Contribution	Reduced Cost	Basis Status	Allowable Min. c(j)	Allowable Max. c(j)
1	X1	1.503.060,0000	8.250.000,0000	12.400.240.000.000,0000	0	basic	6.937,0000	M
2	X2	0	688.014,0000	0	-14.847.790,0000	at bound	-M	15.535.800,0000
3	X3	0	2.885.220,0000	0	-12.650.580,0000	at bound	-M	15.535.800,0000
4	X4	0	7.200.000,0000	0	-2.880.000,0000	at bound	-M	10.080.000,0000
5	X5	0	13.770,0000	0	-16.486.130,0000	at bound	-M	16.499.900,0000
6	X6	4,1187	2.600.000,0000	10.708.680,0000	0	basic	0	35.000.000,0000
7	X7	2.010,6120	5.754.000,0000	11.569.060.000,0000	0	basic	4.110.000,0000	M
	Objective	Function	(Max.) =	12.411.820.000.000,0000				
	Constraint	Left Hand Side	Direction	Right Hand Side	Slack or Surplus	Shadow Price	Allowable Min. RHS	Allowable Max. RHS
1	C1	25.000.000,0000	<=	25.000.000,0000	0	52,0000	24.794.060,0000	130.024.800.000,0000
2	C2	1.202.448,0000	<=	1.202.448,0000	0	10.312.140,0000	0	1.232.402,0000
3	C3	16.527.230,0000	<=	16.527.230,0000	0	648,0000	0	16.733.170,0000
4	C4	4,1187	<=	2.600.000,0000	2.599.996,0000	0	4,0000	M
5	C5	1.503.060,0000	>=	0	1.503.060,0000	0	-M	1.503.060,0000
6	C6	0	>=	0	0	0	-M	0
7	C7	0	>=	0	0	0	-M	0
8	C8	0	>=	0	0	0	-M	0
9	C9	0	>=	0	0	0	-M	0
10	C10	4,1187	>=	0	4,1187	0	-M	4,1187
11	C11	2.010,6120	>=	0	2.010,6120	0	-M	2.010,6120

(Source: Author, 2025)

The results of L&IP are shown in table 4.36 above. According to the results, the value of decision variables X1, X6 and X7 are Kshs 1,503,060.0000, Kshs 4.1187 and Kshs

2,010.6120 respectively. It means that it is viable to produce 1,500,000 of tree seedlings, rehabilitate and maintain 52Km of forest roads and conduct silvicultural treatment of pruning of 700Ha respectively. The other variables X2, X3, X4 and X5 are not economically viable based on the parameter value of the objective function and constraints. The results also show that the reduced cost of these activities X2, X3, X4 and X5 are Kshs -14,847,790.00, Kshs -12,650,500.00, Kshs -2,880,000.00 and Kshs -16,486,130.00 respectively. It means that if these values are added to the correspondent parameter values on the objective function, these activities will be viable to be implemented. The shadow cost of the other constraints is zero. However, the one-unit changes of this constraints do not affect implementation of these activities. The slack variables introduced into the linear constraints of LP were identified as positive for candidate solution, and therefore the particular constraints were non-binding there in the model, as constraints do not restrict the possible changes from that point.

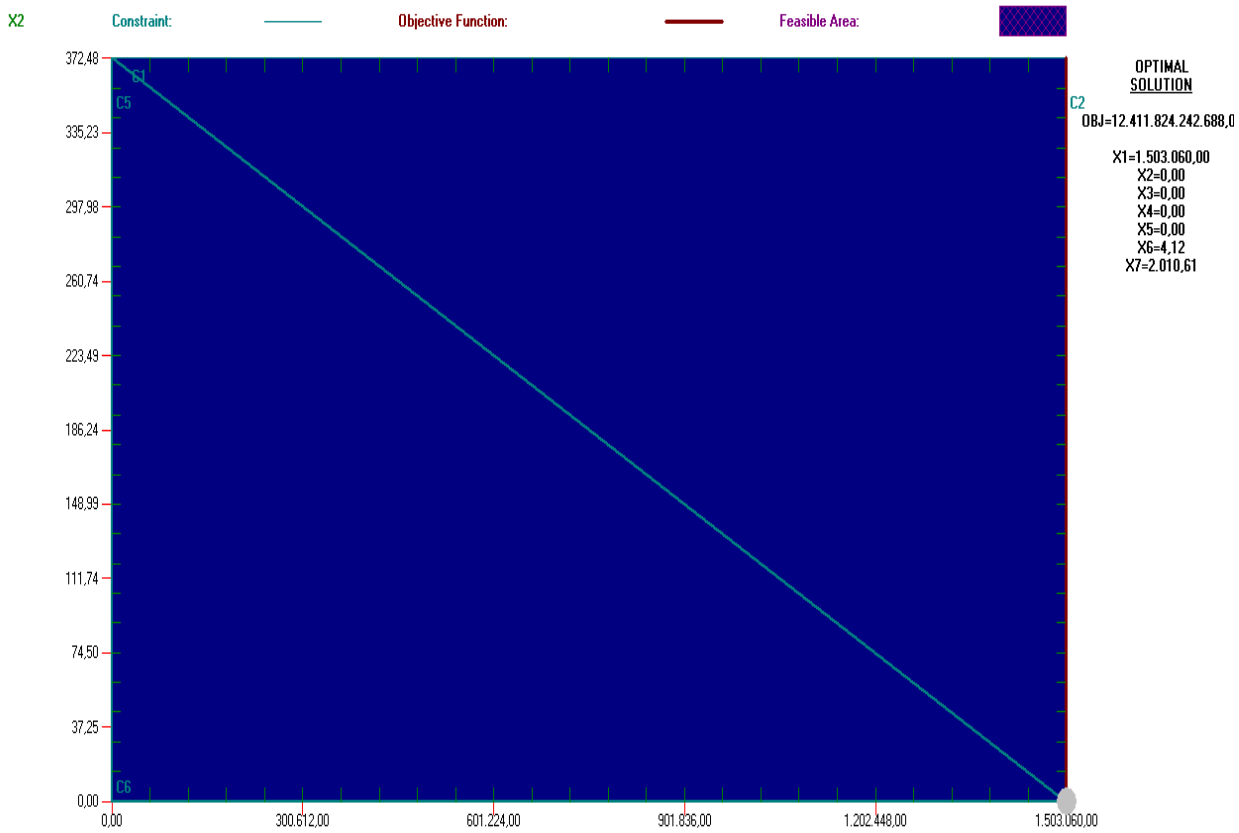

Figure 4.20: Graphical solution of LP model 10 showing feasible region

(Source: Author, 2025)

Figure 4.20 above of Graphical solution of LP model 10, the results show the visualized region shaded providing an optimal solution with objective function value of maximization equals to Kshs 12,411,824,242,688.00 with X1 equals to Kshs 1,503,060.00, X2 equals to Kshs 0.00, X3 equals to Kshs 0.00, X4 equals to Kshs 0.00, X5 equals to Kshs 0.00, X6 equals to Kshs 4.12 and X7 equals to Kshs 2,010.61.

The intersecting region in the graph reflects the decision feasible region as a result of plotting the inequalities in the XY graph. The feasible region provides the optimal

solution as well as what all values the model takes in the optimization as shown in the figure 4.20 above. The feasible solution region on the graph is one which is satisfied by the constraints viewed as the intersection of valid region. The optimum point (**.**) at the intersection gives the values of the decision variables necessary to optimize the objective function after subjecting the values of the parameters into the equation of the objective function. This process results in proving the optimal solution of the problem as indicated on the left side of the graph above.

The value of the basic variables keeps transforming to obtain the maximum value for the objective function. The optimal solution is found when all the coefficients in the objective row are non-negative. This means that the LP model clearly provides optimal performance that will lead to lasting output especially allocation of enough fund for better implementation of the activities towards achievement of planned targets.

11. CFC: Bungoma

Problem statement for feasible models for the AWP&B system optimization for county number eleven.

a) To produce 1,500,000 tree seedlings with a unit cost of Kshs 5.50 per tree seedling production.

b) To establish 450Ha of plantation with a unit cost of Kshs 22,194.00 per hectare of establishment.

c) To rehabilitate 400Ha of natural forests with a unit cost of Kshs 22,194.00 per hectare of rehabilitation.

d) To produce 300 bamboo seedlings with a unit cost of Kshs 9.00 per bamboo seedling production.

e) To rehabilitate and maintain 45Km of forest roads with a unit cost of Kshs 50,000.00 per kilometer of rehabilitation and maintenance.

f) To do a silvicultural treatment (Pruning) of 50Ha with a unit cost of Kshs 8,220.00 per hectare of silvicultural treatment.

g) To determine optimal solution of activities viable to be implemented in the county that minimizes the costs and increases the level of satisfaction of performance.

Table 4.37: LP model 11 optimization formulation and solution

Objective function	
The aim of the objective function is to maximize performance by implementing the six activities in the county while adhering to constraints of budget, raw materials cost, labour cost and machine operation cost due to limited fund allocation. The performance is in terms of the level of activities done.	
MaxZ:8,250,000X1+ 9,987,300X2+8,877,600X3+2,700X4+2,250,000X5 +411,000X6 ≥ 29,778,600	
Where; Z is the objective function that should be maximized.	
X1, X2, X3, X4, X5, X6 are decisions variables (The activities to be implemented) which are; Tree seedling production, Plantation establishment, Natural Forest rehabilitation, Bamboo seedling production, Rehabilitation and maintenance of forest roads and Silvicultural treatment (Pruning) respectively.	
The coefficient of X1, X2, X3, X4, X5, X6 are the unit cost of the decision's variables for the above activities.	
The objective function is subject to the following constraint equations:	
No	**Constraint equation**
1	Budget constraint: 5.5X1+22,194X2+22,194X3+9X4+50,000X5+8,220X6 ≤ 21,000,000
2	Raw materials cost constraint: 0.8X1+1.6X4 ≤ 1,200,480
3	Labour cost constraint: 22,194X2+22,194X3+8,220X6 ≤ 19,275,900
4	Machine operation cost constraint: 50,000X5 ≤ 2,250,000
5	Non-negativity constraint: X1, X2, X3, X4, X5 and X6 ≥ 0

(Source: Author, 2025)

Table 4.37 above shows the results of LP model 11 optimization formulation and solution. It provides identified objective function with six (6) decision variables and ten (10) constraints and explicitly states the non-negativity restriction used for writing down the optimization model.

Table 4.38: Results of LP model 11, solved using L&IP software

	16:33:19		Friday	June	07	2024		
	Decision Variable	Solution Value	Unit Cost or Profit c(j)	Total Contribution	Reduced Cost	Basis Status	Allowable Min. c(j)	Allowable Max. c(j)
1	X1	1.500.600,0000	8.250.000,0000	12.379.950.000.000,0000	0	basic	2.475,0000	M
2	X2	574,3309	9.987.300,0000	5.736.015.000,0000	0	basic	8.877.600,0000	33.291.000.000,0000
3	X3	0	8.877.600,0000	0	-1.109.700,0000	at bound	-M	9.987.300,0000
4	X4	0	2.700,0000	0	-16.496.400,0000	at bound	-M	16.499.100,0000
5	X5	0	2.250.000,0000	0	-20.250.000,0000	at bound	-M	22.500.000,0000
6	X6	0	411.000,0000	0	-3.288.000,0000	at bound	-M	3.699.000,0000
	Objective	Function	(Max.) =	12.385.690.000.000,0000				
	Constraint	Left Hand Side	Direction	Right Hand Side	Slack or Surplus	Shadow Price	Allowable Min. RHS	Allowable Max. RHS
1	C1	21.000.000,0000	<=	21.000.000,0000	0	450,0000	8.253.300,0000	27.529.200,0000
2	C2	1.200.480,0000	<=	1.200.480,0000	0	10.309.410,0000	250.778,2000	3.054.546,0000
3	C3	12.746.700,0000	<=	19.275.900,0000	6.529.200,0000	0	12.746.700,0000	M
4	C4	0	<=	2.250.000,0000	2.250.000,0000	0	0	M
5	C5	1.500.600,0000	>=	0	1.500.600,0000	0	-M	1.500.600,0000
6	C6	574,3309	>=	0	574,3309	0	-M	574,3309
7	C7	0	>=	0	0	0	-M	0
8	C8	0	>=	0	0	0	-M	0
9	C9	0	>=	0	0	0	-M	0
10	C10	0	>=	0	0	0	-M	0

(Source: Author, 2025)

The results of L&IP are shown in table 4.38 above. According to the results, the solution value of decision variables X1 and X2 are Kshs 1,500,600.0000 and Kshs 574.3309 respectively. It means that it is viable to produce 1,500,000 of tree seedlings and establish 450Ha of forests plantation. The other variables X3, X4, X5 and X6 are not economically

viable based on the parameter value of the objective function and constraints. The results also show that the reduced cost of these activities X3, X4, X5 and X6 are Kshs -1,109,700.00, Kshs -16,496,400, Kshs -20,250,500.00 and Kshs -3,288,000.00 respectively. It means that if these values are added to the correspondent parameter values on the objective function, these activities will be viable to be implemented. The shadow cost of the other constraints is zero. However, the one-unit changes of this constraints do not affect implementation of these activities. The slack variables introduced into the linear constraints of LP were identified as positive for candidate solution, and therefore the particular constraints were non-binding there in the model, as constraints do not restrict the possible changes from that point.

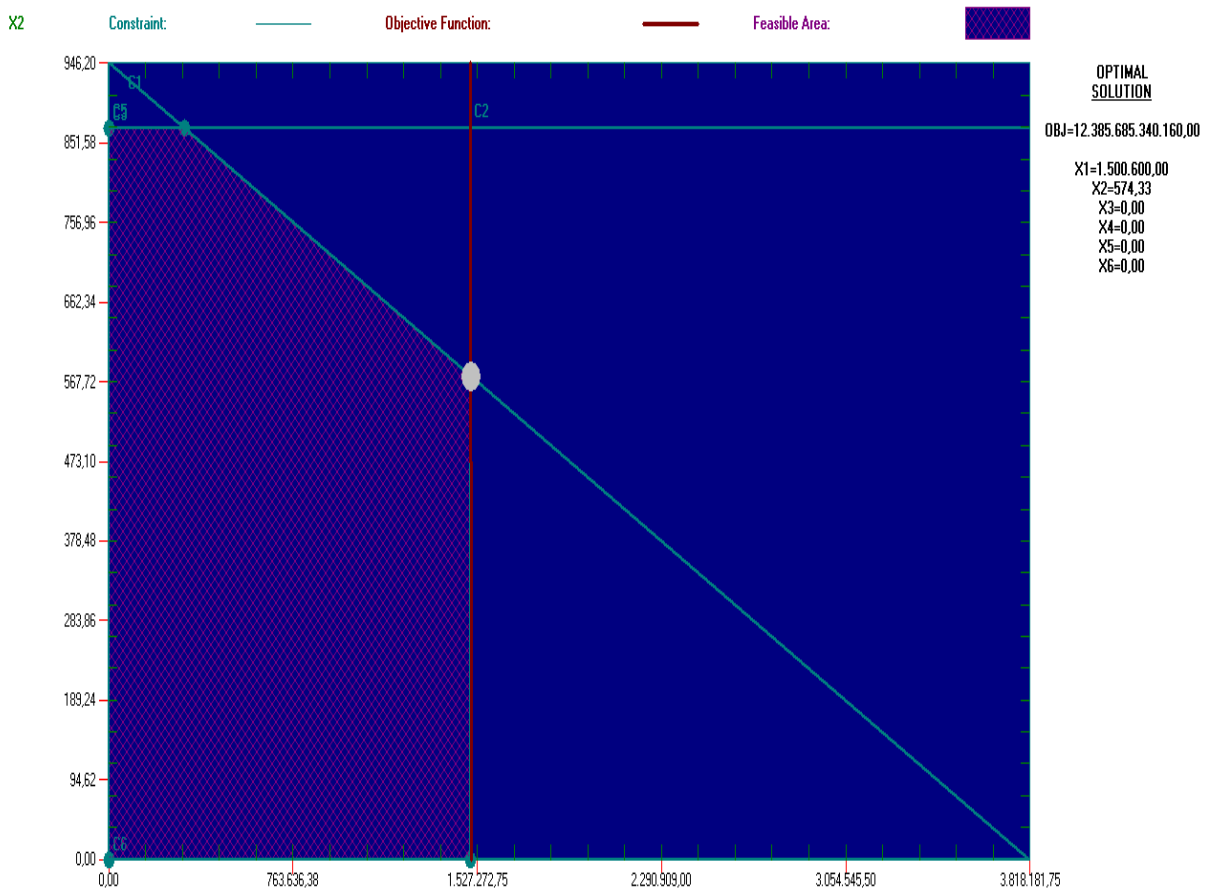

Figure 4.21: Graphical solution of LP model 11 showing feasible region

(Source: Author, 2025)

Figure 4.21 above of Graphical solution of LP model 11, the results show the visualized region shaded providing an optimal solution with objective function value of maximization equals to Kshs 12,385,685,340,160.00 with X1 equals to Kshs 1,500,600.00, X2 equals to Kshs 574.33, X3 equals to Kshs 0.00, X4 equals to Kshs 0.00, X5 equals to Kshs 0.00 and X6 equals to Kshs 0.00.

The intersecting region in the graph reflects the decision feasible region as a result of plotting the inequalities in the XY graph. The feasible region provides the optimal solution as well as what all values the model takes in the optimization as shown in the figure 4.21 above. The feasible solution region on the graph is one which is satisfied by the constraints viewed as the intersection of valid region. The optimum point (**.**) at the intersection gives the values of the decision variables necessary to optimize the objective function after subjecting the values of the parameters into the equation of the objective function. This process results in proving the optimal solution of the problem as indicated on the left side of the graph above.

The value of the basic variables keeps transforming to obtain the maximum value for the objective function. The optimal solution is found when all the coefficients in the objective row are non-negative. This means that the LP model clearly provides optimal performance that will lead to lasting output especially allocation of enough fund for better implementation of the activities towards achievement of planned targets.

12. CFC: Kajiado

Problem statement for feasible models for the AWP&B system optimization for county number twelve.

a) To produce 1,500,000 tree seedlings with a unit cost of Kshs 5.50 per tree seedling production.

b) To establish 100Ha of plantation with a unit cost of Kshs 22,194.00 per hectare of establishment.

c) To rehabilitate 400Ha of natural forests with a unit cost of Kshs 22,194.00 per hectare of rehabilitation.

d) To rehabilitate and maintain 43Km of forest roads with a unit cost of Kshs 50,000.00 per kilometer of rehabilitation and maintenance.

e) To do a silvicultural treatment (Pruning) of 613Ha with a unit cost of Kshs 8,220.00 per hectare of silvicultural treatment.

f) To determine optimal solution of activities viable to be implemented in the county that minimizes the costs and increases the level of satisfaction of performance.

Table 4.39: Kajiado CFCs LP model 12 optimization formulation and solution

Objective function	
The aim of the objective function is to maximize performance by implementing the five activities in the county while adhering to constraints of budget, raw materials cost, labour cost and machine operation cost due to limited fund allocation. The performance is in terms of the level of activities done.	
MaxZ:8,250,000X1+ 2,219,400X2+8,877,600X3+2,150,000X4+5,038,860X5 ≥ 21,497,000	
Where; Z is the objective function that should be maximized.	
X1, X2, X3, X4, X5 are decisions variables (The activities to be implemented) which are; Tree seedling production, Plantation establishment, Natural Forest rehabilitation, Rehabilitation and maintenance of forest roads and Silvicultural treatment (Pruning) respectively.	
The coefficient of X1, X2, X3, X4, X5 are the unit cost of the decision's variables for the above activities.	
The objective function is subject to the following constraint equations:	
No	**Constraint equation**
1	Budget constraint: 5.5X1+22,194X2+22,194X3+50,000X4+8,220X5 ≤ 18,000,000
2	Raw materials cost constraint: 0.8X1 ≤ 1,200,000
3	Labour cost constraint: 22,194X2+22,194X3+8,220X5 ≤ 16,135,860
4	Machine operation cost constraint: 50,000X4 ≤ 2,150,000
5	Non-negativity constraint: X1, X2, X3, X4 and X5 ≥ 0

(Source: Author, 2025)

Table 4.39 above shows the results of LP model 12 optimization formulation and solution. It provides identified objective function with five (5) decision variables and nine (9) constraints and explicitly states the non-negativity restriction used for writing down the optimization model.

Table 4.40: Results of LP model 12, solved using L&IP software

	16:46:40		Friday	June	07	2024		
	Decision Variable	Solution Value	Unit Cost or Profit c(j)	Total Contribution	Reduced Cost	Basis Status	Allowable Min. c(j)	Allowable Max. c(j)
1	X1	1.200.000,0000	8.250.000,0000	9.900.000.000.000,0000	0	basic	3.371,5000	M
2	X2	0	2.219.400,0000	0	-11.385.520,0000	at bound	-M	13.604.920,0000
3	X3	0	8.877.600,0000	0	-4.727.322,0000	at bound	-M	13.604.920,0000
4	X4	0	2.150.000,0000	0	-28.500.000,0000	at bound	-M	30.650.000,0000
5	X5	1.386,8610	5.038.860,0000	6.988.200.000,0000	0	basic	3.288.000,0000	12.330.000.000,0000
	Objective	Function	(Max.) =	9.906.988.000.000,0000				
	Constraint	Left Hand Side	Direction	Right Hand Side	Slack or Surplus	Shadow Price	Allowable Min. RHS	Allowable Max. RHS
1	C1	18.000.000,0000	<=	18.000.000,0000	0	613,0000	6.600.000,0000	22.735.860,0000
2	C2	1.200.000,0000	<=	1.200.000,0000	0	8.246.629,0000	338.934,6000	3.272.727,0000
3	C3	11.400.000,0000	<=	16.135.860,0000	4.735.860,0000	0	11.400.000,0000	M
4	C4	0	<=	2.150.000,0000	2.150.000,0000	0	0	M
5	C5	1.200.000,0000	>=	0	1.200.000,0000	0	-M	1.200.000,0000
6	C6	0	>=	0	0	0	-M	0
7	C7	0	>=	0	0	0	-M	0
8	C8	0	>=	0	0	0	-M	0
9	C9	1.386,8610	>=	0	1.386,8610	0	-M	1.386,8610

(Source: Author, 2025)

The results of L&IP are shown in table 4.40 above. According to the results, the value of decision variables X1 and X5 are Kshs 1,200,000.0000 and Kshs 1,386.8610 respectively. It means that it is viable to produce 1,500,000 of tree seedlings and conduct

a silvicultural treatment of pruning of 613Ha in the CFC. The other variables X2, X3 and X4 are not economically viable based on the parameter value of the objective function and constraints. The results also show that the reduced cost of these activities X2, X3 and X4 are Kshs -11,385,520.00, Kshs -4,727,322.00 and Kshs -28,500,000.00 respectively. It means that if these values are added to the correspondent parameter values on the objective function, these activities will be viable to be implemented. The shadow cost of the other constraints is zero. However, the one-unit changes of this constraints do not affect implementation of these activities. The slack variables introduced into the linear constraints of LP were identified as positive for candidate solution, and therefore the particular constraints were non-binding there in the model, as constraints do not restrict the possible changes from that point.

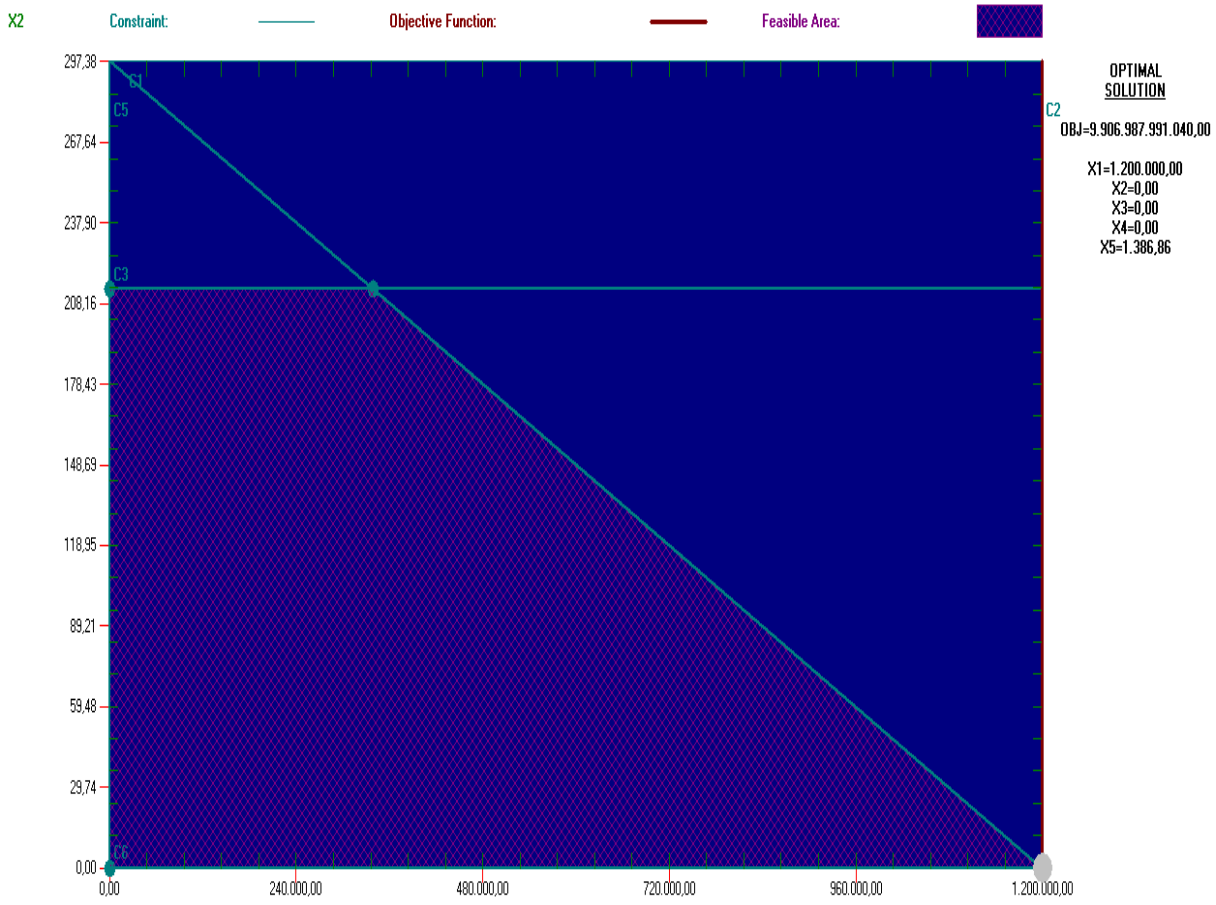

Figure 4.22: Graphical solution of LP model 12 showing feasible region

(Source: Author, 2025)

Figure 4.22 above of Graphical solution of LP model 12, the results show the visualized region shaded providing an optimal solution with objective function value of maximization equals to Kshs 9,906,987,991,040.00 with X1 equals to Kshs 1,200,000.00, X2 equals to Kshs 0.00, X3 equals to Kshs 0.00, X4 equals to Kshs 0.00 and X5 equals to Kshs 1,386.86.

The intersecting region in the graph reflects the decision feasible region as a result of plotting the inequalities in the XY graph. The feasible region provides the optimal solution as well as what all values the model takes in the optimization as shown in the figure 4.22 above. The feasible solution region on the graph is one which is satisfied by the constraints viewed as the intersection of valid region. The optimum point (**.**) at the intersection gives the values of the decision variables necessary to optimize the objective function after subjecting the values of the parameters into the equation of the objective function. This process results in proving the optimal solution of the problem as indicated on the left side of the graph above.

The value of the basic variables keeps transforming to obtain the maximum value for the objective function. The optimal solution is found when all the coefficients in the objective row are non-negative. This means that the LP model clearly provides optimal performance that will lead to lasting output especially allocation of enough fund for better implementation of the activities towards achievement of planned targets.

13. CFC: Trans Nzoia

Problem statement for feasible models for the AWP&B system optimization for county number thirteen.

a) To produce 1,000,000 tree seedlings with a unit cost of Kshs 5.50 per tree seedling production.

b) To establish 500Ha of plantation with a unit cost of Kshs 22,194.00 per hectare of establishment.

c) To rehabilitate 100Ha of natural forests with a unit cost of Kshs 22,194.00 per hectare of rehabilitation.

d) To produce 900 bamboo seedlings with a unit cost of Kshs 9.00 per bamboo seedling production.

e) To rehabilitate and maintain 70Km of forest roads with a unit cost of Kshs 50,000.00 per kilometer of rehabilitation and maintenance.

f) To do a silvicultural treatment (Pruning) of 490Ha with a unit cost of Kshs 8,220.00 per hectare of silvicultural treatment.

g) To determine optimal solution of activities viable to be implemented in the county that minimizes the costs and increases the level of satisfaction of performance.

Table 4.41: Trans Nzoia CFCs LP model 13 optimization formulation and solution

Objective function	
The aim of the objective function is to maximize performance by implementing the six activities in the county while adhering to constraints of budget, raw materials cost, labour cost and machine operation cost due to limited fund allocation. The performance is in terms of the level of activities done.	
MaxZ:5,500,000X1+ 11,097,000X2+2,219,400X3+8,100X4+3,500,000X5 +4,027,800X6 ≥ 26,352,300	
Where; Z is the objective function that should be maximized.	
X1, X2, X3, X4, X5, X6 are decisions variables (The activities to be implemented) which are; Tree seedling production, Plantation establishment, Natural Forest rehabilitation, Bamboo seedling production, Rehabilitation and maintenance of forest roads and Silvicultural treatment (Pruning) respectively.	
The coefficient of X1, X2, X3, X4, X5, X6 are the unit cost of the decision's variables for the above activities.	
The objective function is subject to the following constraint equations:	
No	**Constraint equation**
1	Budget constraint: 5.5X1+22,194X2+22,194X3+9X4+50,000X5+8,220X6 ≤ 25,000,000
2	Raw materials cost constraint: 0.8X1+1.6X4 ≤ 801,440
3	Labour cost constraint: 22,194X2+22,194X3+8,220X6 ≤ 17,344,200
4	Machine operation cost constraint: 50,000X6 ≤ 3,500,000
5	Non-negativity constraint: X1, X2, X3, X4, X5 and X6 ≥ 0

(Source: Author, 2025)

Table 4.41 above shows the results of LP model 13 optimization formulation and solution. It provides identified objective function with six (6) decision variables and ten

(10) constraints and explicitly states the non-negativity restriction used for writing down the optimization model.

Table 4.42: Results of LP model 13, solved using L&IP software

	17:01:45		Friday	June	07	2024		
	Decision Variable	Solution Value	Unit Cost or Profit c(j)	Total Contribution	Reduced Cost	Basis Status	Allowable Min. c(j)	Allowable Max. c(j)
1	X1	1.001.800,0000	5.500.000,0000	5.509.900.000.000,0000	0	basic	4.120,0000	M
2	X2	781,4815	11.097.000,0000	8.672.100.000,0000	0	basic	10.875.060,0000	M
3	X3	0	2.219.400,0000	0	-8.877.600,0000	at bound	-M	11.097.000,0000
4	X4	0	8.100,0000	0	-10.991.760,0000	at bound	-M	10.999.860,0000
5	X5	42,9180	3.500.000,0000	150.213.000,0000	0	basic	0	25.000.000,0000
6	X6	0	4.027.800,0000	0	-82.200,0000	at bound	-M	4.110.000,0000
	Objective	Function	(Max.) =	5.518.723.000.000,0000				
	Constraint	Left Hand Side	Direction	Right Hand Side	Slack or Surplus	Shadow Price	Allowable Min. RHS	Allowable Max. RHS
1	C1	25.000.000,0000	<=	25.000.000,0000	0	70,0000	22.854.100,0000	M
2	C2	801.440,0000	<=	801.440,0000	0	6.874.519,0000	0	1.113.571,0000
3	C3	17.344.200,0000	<=	17.344.200,0000	0	430,0000	0	19.490.100,0000
4	C4	0	<=	3.500.000,0000	3.500.000,0000	0	0	M
5	C5	1.001.800,0000	>=	0	1.001.800,0000	0	-M	1.001.800,0000
6	C6	781,4815	>=	0	781,4815	0	-M	781,4815
7	C7	0	>=	0	0	0	-M	0
8	C8	0	>=	0	0	0	-M	0
9	C9	42,9180	>=	0	42,9180	0	-M	42,9180
10	C10	0	>=	0	0	0	-M	0

(Source: Author, 2025)

The results of L&IP are shown in table 4.42 above. According to the results, the value of decision variables X1, X2 and X5 are Kshs 1,001,800.0000, Kshs 781.4815 and 42.9180 respectively. It means that it is viable to produce 1,500,000 of tree seedlings, establish 100Ha of plantation and conduct silvicultural treatment of pruning of 613Ha. The other

variables X3, X4 and X6 are not economically viable based on the parameter value of the objective function and constraints. The results also show that the reduced cost of these activities X3, X4 and X6 are Kshs -8,877,600.0000, Kshs -10,991,760.0000 and Kshs -82,200.0000 respectively. It means that if these values are added to the correspondent parameter values on the objective function, these activities will be viable to be implemented. The shadow cost of the other constraints is zero. However, the one-unit changes of this constraints do not affect implementation of these activities. The slack variables introduced into the linear constraints of LP were identified as positive for candidate solution, and therefore the particular constraints were non-binding there in the model, as constraints do not restrict the possible changes from that point.

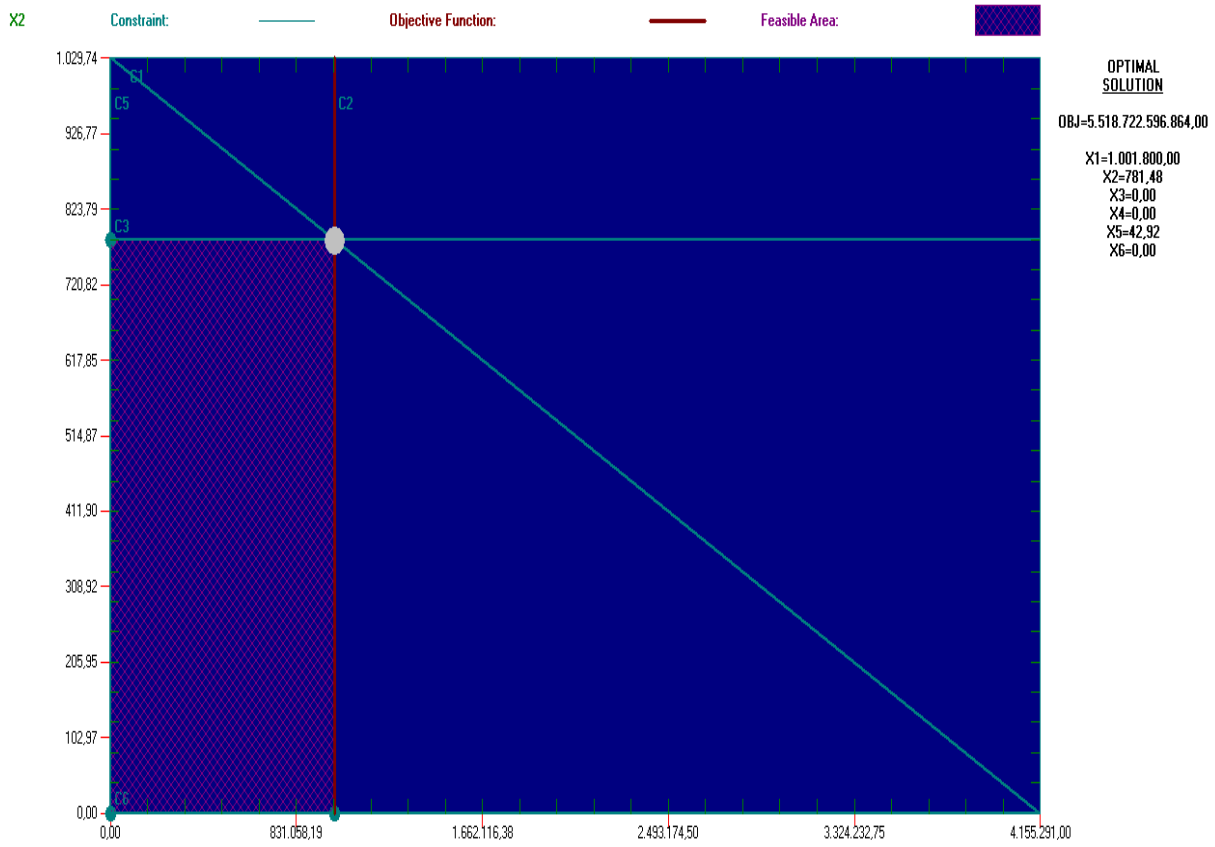

Figure 4.23: Graphical solution of LP model 13 showing feasible region

(Source: Author, 2025)

Figure 4.23 above of Graphical solution of LP model 13, the results show the visualized region shaded providing an optimal solution with objective function value of maximization equals to Kshs 5,518,722,596,864.00 with X1 equals to Kshs 1,001,800.00, X2 equals to Kshs 781.48, X3 equals to Kshs 0.00, X4 equals to Kshs 0.00, X5 equals to Kshs 42.92 and X6 equals to Kshs 0.00.

The intersecting region in the graph reflects the decision feasible region as a result of plotting the inequalities in the XY graph. The feasible region provides the optimal solution as well as what all values the model takes in the optimization as shown in the figure 4.23 above. The feasible solution region on the graph is one which is satisfied by the constraints viewed as the intersection of valid region. The optimum point (**.**) at the intersection gives the values of the decision variables necessary to optimize the objective function after subjecting the values of the parameters into the equation of the objective function. This process results in proving the optimal solution of the problem as indicated on the left side of the graph above.

The value of the basic variables keeps transforming to obtain the maximum value for the objective function. The optimal solution is found when all the coefficients in the objective row are non-negative. This means that the LP model clearly provides optimal performance that will lead to lasting output especially allocation of enough fund for better implementation of the activities towards achievement of planned targets.

14. CFC: Migori

Problem statement for feasible models for the AWP&B system optimization for county number fourteen.

a) To produce 1,000,000 tree seedlings with a unit cost of Kshs 5.50 per tree seedling production.

b) To establish 30Ha of plantation with a unit cost of Kshs 22,194.00 per hectare of establishment.

c) To establish 800Ha of commercial farm forests with a unit cost of Kshs 14,400.00 per hectare of establishment.

d) To do a silvicultural treatment (Pruning) of 30Ha with a unit cost of Kshs 8,220.00 per hectare silvicultural treatment.

e) To determine optimal solution of activities viable to be implemented in the county that minimizes the costs and increases the level of satisfaction of performance.

Table 4.43: LP model 14 optimization formulation and solution

Objective function	
The aim of the objective function is to maximize performance by implementing the five activities in the county while adhering to constraints of budget, raw materials cost, labour cost and machine operation cost due to limited fund allocation. The performance is in terms of the level of activities done.	
MaxZ:5,500,000X1+ 665,820X2+11,520,000X3+1,600,000X4+246,600X5 ≥ 19,532,420	
Where; Z is the objective function that should be maximized.	
X1, X2, X3, X4, X5 are decisions variables (The activities to be implemented) which are; Tree seedling production, Plantation establishment, Commercial farm forest establishment, Rehabilitation and maintenance of forest roads and Silvicultural treatment (Pruning) respectively.	
The coefficient of X1, X2, X3, X4, X5 are the unit cost of the decision's variables for the above activities.	
The objective function is subject to the following constraint equations:	
No	**Constraint equation**
1	Budget constraint: 5.5X1+22,194X2+14,400X3+50,000X4+8,220X5 ≤ 18,000,000
2	Raw materials cost constraint: 0.8X1 ≤ 800,000
3	Labour cost constraint: 22,194X2+14,400X3+8,220X5 ≤ 12,432,420
4	Machine operation cost constraint: 50,000X4 ≤ 1,600,000
5	Non-negativity constraint: X1, X2, X3, X4 and X5 ≥ 0

(Source: Author, 2025)

Table 4.43 above shows the results of LP model 14 optimization formulation and solution. It provides identified objective function with seven (5) decision variables and

nine (9) constraints and explicitly states the non-negativity restriction used for writing down the optimization model.

Table 4.44: Results of LP model 14, solved using L&IP software

	17:15:02		Friday	June	07	2024		
	Decision Variable	Solution Value	Unit Cost or Profit c[j]	Total Contribution	Reduced Cost	Basis Status	Allowable Min. c[j]	Allowable Max. c[j]
1	X1	800.000,0000	5.500.000,0000	4.400.000.000.000,0000	0	basic	176,0000	M
2	X2	0	665.820,0000	0	-17.089.380,0000	at bound	-M	17.755.200,0000
3	X3	863,3625	11.520.000,0000	9.945.936.000,0000	0	basic	460.800,0000	M
4	X4	23,3516	1.600.000,0000	37.362.560,0000	0	basic	0	40.000.000,0000
5	X5	0	246.600,0000	0	-6.329.400,0000	at bound	-M	6.576.000,0000
	Objective	Function	(Max.) =	4.409.983.000.000,0000				
	Constraint	Left Hand Side	Direction	Right Hand Side	Slack or Surplus	Shadow Price	Allowable Min. RHS	Allowable Max. RHS
1	C1	18.000.000,0000	<=	18.000.000,0000	0	32,0000	16.832.420,0000	80.016.830.000,0000
2	C2	800.000,0000	<=	800.000,0000	0	5.499.824,0000	0	1.012.287,0000
3	C3	12.432.420,0000	<=	12.432.420,0000	0	768,0000	0	13.600.000,0000
4	C4	23,3516	<=	1.600.000,0000	1.599.977,0000	0	23,3750	M
5	C5	800.000,0000	>=	0	800.000,0000	0	-M	800.000,0000
6	C6	0	>=	0	0	0	-M	0
7	C7	863,3625	>=	0	863,3625	0	-M	863,3625
8	C8	23,3516	>=	0	23,3516	0	-M	23,3516
9	C9	0	>=	0	0	0	-M	0

(Source: Author, 2025)

The results of L&IP are shown in table 4.44 above. According to the results, the value of decision variables X1, X3 and X4 are Kshs 800,000.0000, Kshs 863.3625 and Kshs 23.3516 respectively. It means that it is viable to produce 1,000,000 tree seedlings, establish 800Ha of commercial farm forests and rehabilitate and maintain 32Km of forest roads. The other variables X2 and X5 are not economically viable based on the parameter value of the objective function and constraints. The results also show that the reduced

cost of these activities X2 and X5 are Kshs -17,089,380.00 and Kshs -6,329,400.00 respectively. It means that if these values are added to the correspondent parameter values on the objective function, these activities will be viable to be implemented. The shadow cost of the other constraints is zero. However, the one-unit changes of this constraints do not affect implementation of these activities. The slack variables introduced into the linear constraints of LP were identified as positive for candidate solution, and therefore the particular constraints were non-binding there in the model, as constraints do not restrict the possible changes from that point.

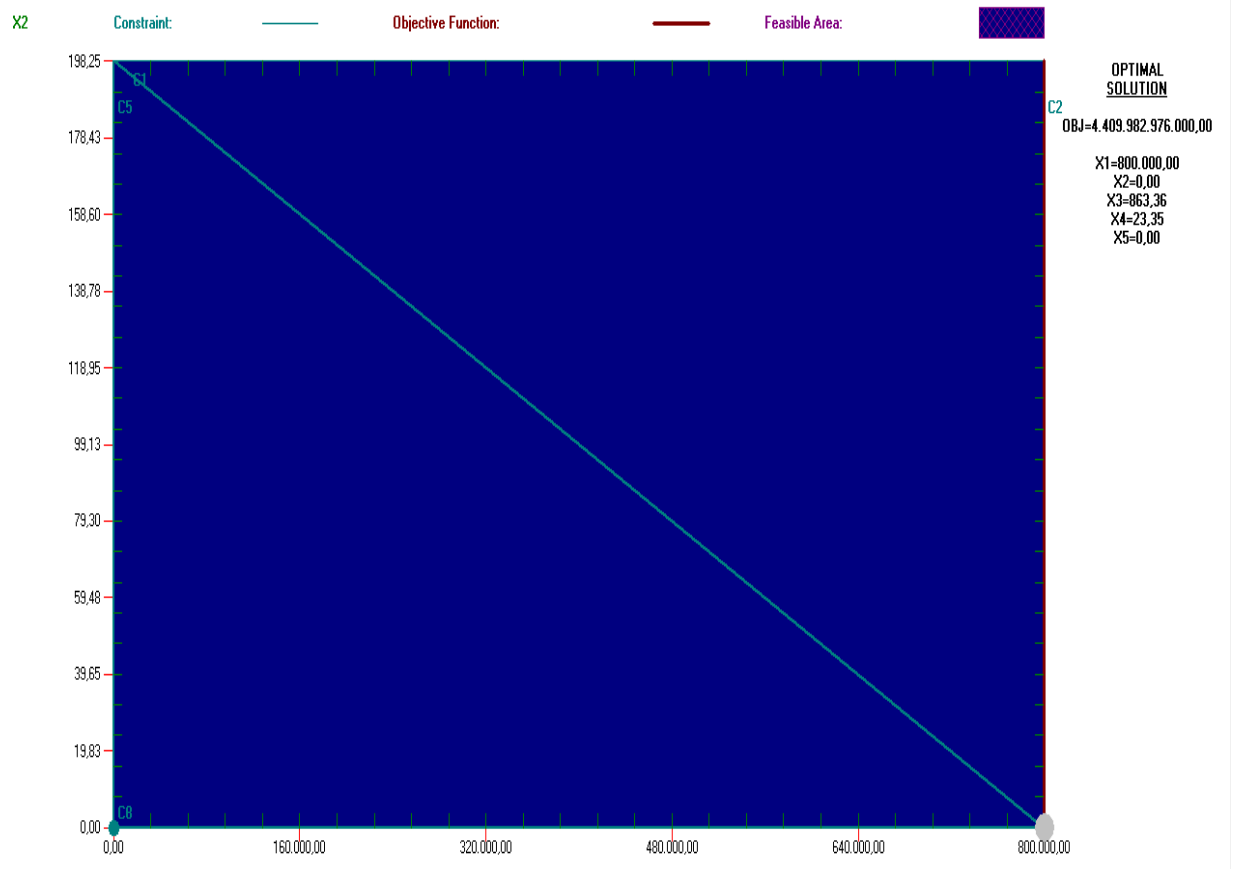

Figure 4.24: Graphical solution of LP model 14 showing feasible region

(Source: Author, 2025)

According to Figure 4.24 above of Graphical solution of LP model 14 showing visualized region, the results showed an optimal solution with objective function value of maximization equals to 4,409,982,976,000.00 with X1 equals to 800,000.00, X2 equals to 0, X3 equals to 863.36, X4 equals to 23.35 and X5 equals to 0.

The intersecting region in the graph reflects the decision feasible region as a result of plotting the inequalities in the XY graph. The feasible region provides the optimal solution as well as what all values the model takes in the optimization as shown in the figure 4.24 above. The feasible solution region on the graph is one which is satisfied by the constraints viewed as the intersection of valid region. The optimum point (**.**) at the intersection gives the values of the decision variables necessary to optimize the objective function after subjecting the values of the parameters into the equation of the objective function. This process results in proving the optimal solution of the problem as indicated on the left side of the graph above.

The value of the basic variables keeps transforming to obtain the maximum value for the objective function. The optimal solution is found when all the coefficients in the objective row are non-negative. This means that the LP model clearly provides optimal performance that will lead to lasting output especially allocation of enough fund for better implementation of the activities towards achievement of planned targets.

15. CFC: Siaya

Problem statement for feasible models for the AWP&B system optimization for county number fifteen.

a) To produce 1,000,000 tree seedlings with a unit cost of Kshs 5.50 per tree seedling production.

b) To establish 30Ha of plantation with a unit cost of Kshs 22,194.00 per hectare of establishment.

c) To establish 900Ha of commercial farm forests with a unit cost of Kshs 14,400.00 per hectare of establishment.

d) To produce 500 bamboo seedlings with a unit cost of Kshs 9.00 per bamboo seedling production.

e) To determine optimal solution of activities viable to be implemented in the county that minimizes the costs and increases the level of satisfaction of performance.

Table 4.45: LP model 15 optimization formulation and solution

Objective function	
The aim of the objective function is to maximize performance by implementing the four activities in the county while adhering to constraints of budget, raw materials cost and labour cost due to limited fund allocation. The performance is in terms of the level of activities done.	
MaxZ:5,500,000X1+ 665,820X2+12,960,000X3+4,500X4 ≥ 19,130,320	
Where; Z is the objective function that should be maximized.	
X1, X2, X3, X4 are decisions variables (The activities to be implemented) which are; Tree seedling production, Natural Forest rehabilitation, Commercial farm forest establishment and Bamboo seedling production respectively.	
The coefficient of X1, X2, X3, X4 are the unit cost of the decision's variables for the above activities.	
The objective function is subject to the following constraint equations:	
No	**Constraint equation**
1	Budget constraint: 5.5X1+22,194X2+14,400X3+9X4 ≤ 18,000,000
2	Raw materials cost constraint: 0.8X1+1.6X4 ≤ 800,800
3	Labour cost constraint: 22,194X2+14,400X3 ≤ 12,686,490
4	Non-negativity constraint: X1, X2, X3and X4 ≥ 0

(Source: Author, 2025)

Table 4.45 above shows the results of LP model 15 optimization formulation and solution. It provides identified objective function with four (4) decision variables and seven (7) constraints and explicitly states the non-negativity restriction used for writing down the optimization model.

Table 4.46: Results of LP model 15, solved using L&IP software

	17:24:23		Friday	June	07	2024		
	Decision Variable	Solution Value	Unit Cost or Profit c[j]	Total Contribution	Reduced Cost	Basis Status	Allowable Min. c[j]	Allowable Max. c[j]
1	X1	1.001.000,0000	5.500.000,0000	5.505.500.000.000,0000	0	basic	4.950,0000	M
2	X2	0	665.820,0000	0	-19.308.780,0000	at bound	-M	19.974.600,0000
3	X3	867,6736	12.960.000,0000	11.245.050.000,0000	0	basic	432.000,0000	14.400.000.000,0000
4	X4	0	4.500,0000	0	-10.993.700,0000	at bound	-M	10.998.200,0000
	Objective	Function	(Max.) =	5.516.745.000.000,0000				
	Constraint	Left Hand Side	Direction	Right Hand Side	Slack or Surplus	Shadow Price	Allowable Min. RHS	Allowable Max. RHS
1	C1	18.000.000,0000	<=	18.000.000,0000	0	900,0000	5.505.500,0000	18.191.990,0000
2	C2	800.800,0000	<=	800.800,0000	0	6.868.813,0000	772.874,2000	2.618.182,0000
3	C3	12.494.500,0000	<=	12.686.490,0000	191.989,9000	0	12.494.500,0000	M
4	C4	1.001.000,0000	>=	0	1.001.000,0000	0	-M	1.001.000,0000
5	C5	0	>=	0	0	0	-M	0
6	C6	867,6736	>=	0	867,6736	0	-M	867,6736
7	C7	0	>=	0	0	0	-M	0

(Source: Author, 2025)

The results of L&IP are shown in table 4.46 above. According to the results, the value of decision variables X1 and X3 are Kshs 1,001,000.0000 and Kshs 867.6736 respectively. It means that it is viable to produce 1,000,000 of tree seedlings and establish 900Ha of

commercial farm forests respectively. The other variables X2 and X4 are not economically viable based on the parameter value of the objective function and constraints. The results also show that the reduced cost of these activities X2 and X4 are Kshs -19,308,780.0000 and Kshs -10,993,700.0000 respectively. It means that if these values are added to the correspondent parameter values on the objective function, these activities will be viable to be implemented. The shadow cost of the other constraints is zero. However, the one-unit changes of this constraints do not affect implementation of these activities. The slack variables introduced into the linear constraints of LP were identified as positive for candidate solution, and therefore the particular constraints were non-binding there in the model, as constraints do not restrict the possible changes from that point.

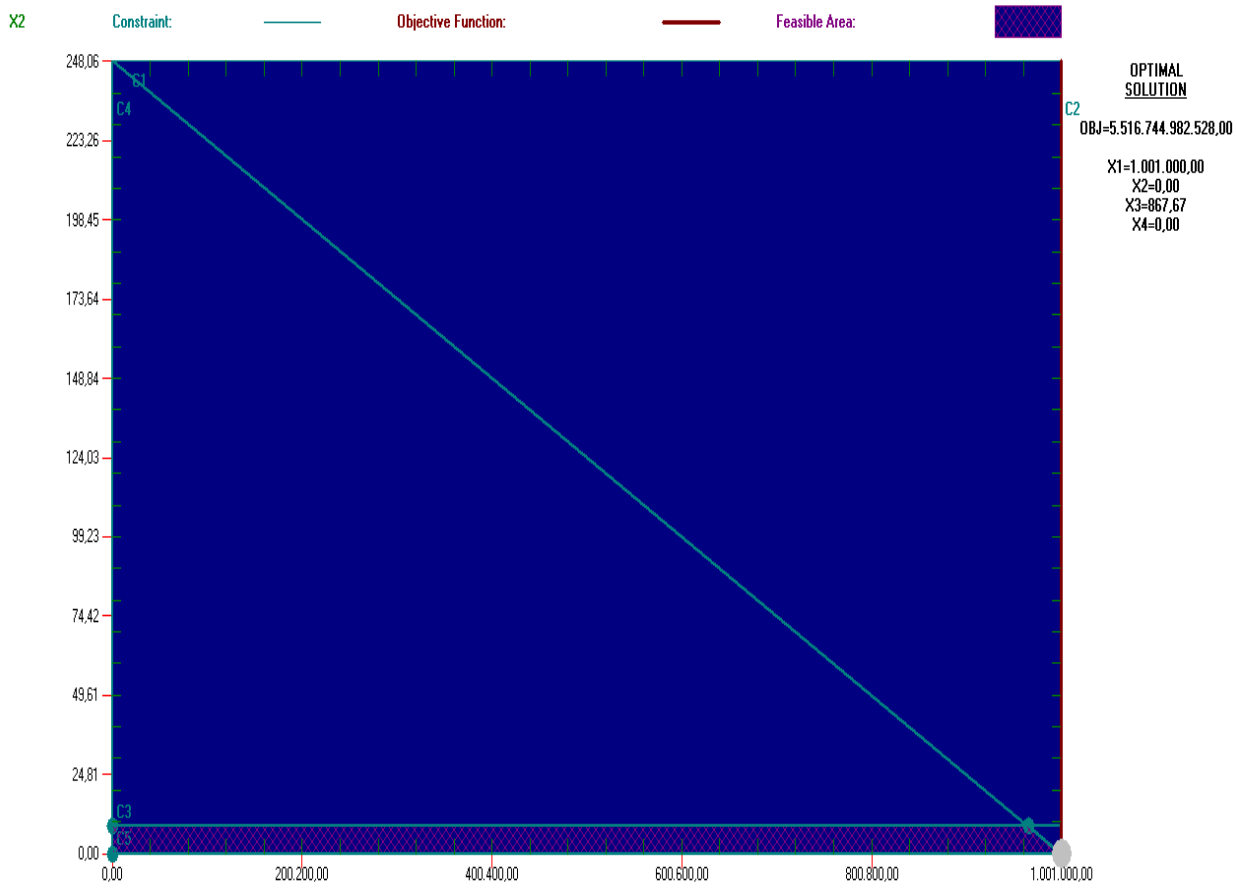

Figure 4.25: Graphical solution of LP 15 model showing feasible region

(Source: Author, 2025)

Figure 4.25 above of Graphical solution of LP model 15, the results show the visualized region shaded providing an optimal solution with objective function value of maximization equals to Kshs 5,516,744,982,528.00 with X1 equals to Kshs 1,001,000.00, X2 equals to Kshs 0.00, X3 equals to Kshs 867.67 and X4 equals to Kshs 0.00.

The intersecting region in the graph reflects the decision feasible region as a result of plotting the inequalities in the XY graph. The feasible region provides the optimal

solution as well as what all values the model takes in the optimization as shown in the figure 4.25 above. The feasible solution region on the graph is one which is satisfied by the constraints viewed as the intersection of valid region. The optimum point (**.**) at the intersection gives the values of the decision variables necessary to optimize the objective function after subjecting the values of the parameters into the equation of the objective function. This process results in proving the optimal solution of the problem as indicated on the left side of the graph above.

The value of the basic variables keeps transforming to obtain the maximum value for the objective function. The optimal solution is found when all the coefficients in the objective row are non-negative. This means that the LP model clearly provides optimal performance that will lead to lasting output especially allocation of enough fund for better implementation of the activities towards achievement of planned targets.

16. CFC: Nandi

Problem statement for feasible models for the AWP&B system optimization for county number sixteen.

a) To produce 1,500,000 tree seedlings with a unit cost of Kshs 5.50 per tree seedling production.

b) To establish 480Ha of plantation with a unit cost of Kshs 22,194.00 per hectare of establishment.

c) To rehabilitate 43Ha of natural forests with a unit cost of Kshs 22,194.00 per hectare of rehabilitation.

d) To establish 500Ha of commercial farm forests with a unit cost of Kshs 14,400.00 per hectare of establishment.

e) To produce 3,000 bamboo seedlings with a unit cost of Kshs 9.00 per bamboo seedling production.

f) To rehabilitate and maintain 62Km of forest roads with a unit cost of Kshs 50,000.00 per kilometer of rehabilitation and maintenance.

g) To do a silvicultural treatment (Pruning) of 226Ha with a unit cost of Kshs 8,220.00 per hectare of silvicultural treatment.

h) To determine optimal solution of activities viable to be implemented in the county that minimizes the costs and increases the level of satisfaction of performance.

Table 4.47: LP model 16 optimization formulation and solution

Objective function	
The aim of the objective function is to maximize performance by implementing the seven activities in the county while adhering to constraints of budget, raw materials cost, labour cost and machine operation cost due to limited fund allocation. The performance is in terms of the level of activities done.	
MaxZ:8,250,000X1+ 10,653,120X2+954,342X3+7,200,000X4+27000X5 +3,100,000X6+ 1,857,720X7 ≥ 32,042,182	
Where; Z is the objective function that should be maximized.	
X1, X2, X3, X4, X5, X6, X7 are decisions variables (The activities to be implemented) which are; Tree seedling production, Plantation establishment, Natural Forest rehabilitation, Commercial farm forest establishment, Bamboo seedling production, Rehabilitation and maintenance of forest roads and Silvicultural treatment (Pruning) respectively.	
The coefficient of X1, X2, X3, X4, X5, X6, X7 are the unit cost of the decision's variables for the above activities.	
The objective function is subject to the following constraint equations:	
No	**Constraint equation**
1	Budget constraint: 5.5X1+22,194X2+22,194X3+14,400X4+9X5+50,000X6+8,220X7 ≤ 29,000,000
2	Raw materials cost constraint: 0.8X1+1.6X5 ≤ 1,204,800
3	Labour cost constraint: 22,194X2+22,194X3+14,400X4+8,220X7 ≤ 20,665,182
4	Machine operation cost constraint: 50,000X6 ≤ 3,100,000
5	Non-negativity constraint: X1, X2, X3, X4, X5, X6 and X7 ≥ 0

(Source: Author, 2025)

Table 4.47 above shows the results of LP model 16 optimization formulation and solution. It provides identified objective function with seven (7) decision variables and eleven (11) constraints and explicitly states the non-negativity restriction used for writing down the optimization model.

Table 4.48: Results of LP model 16, solved using L&IP software

	17:36:41		Friday	June	07	2024		
	Decision Variable	Solution Value	Unit Cost or Profit c(j)	Total Contribution	Reduced Cost	Basis Status	Allowable Min. c(j)	Allowable Max. c(j)
1	X1	1.506.000,0000	8.250.000,0000	12.424.500.000.000,0000	0	basic	13.562,0000	M
2	X2	0	10.653.120,0000	0	-443.880,0000	at bound	-M	11.097.000,0000
3	X3	0	954.342,0000	0	-10.142.660,0000	at bound	-M	11.097.000,0000
4	X4	1.435,0820	7.200.000,0000	10.332.590.000,0000	0	basic	6.912.000,0000	M
5	X5	0	27.000,0000	0	-16.472.880,0000	at bound	-M	16.499.880,0000
6	X6	1,0364	3.100.000,0000	3.212.724,0000	0	basic	0	25.000.000,0000
7	X7	0	1.857.720,0000	0	-2.252.280,0000	at bound	-M	4.110.000,0000
	Objective	Function	(Max.) =	12.434.840.000.000,0000				
	Constraint	Left Hand Side	Direction	Right Hand Side	Slack or Surplus	Shadow Price	Allowable Min. RHS	Allowable Max. RHS
1	C1	29.000.000,0000	<=	29.000.000,0000	0	62,0000	28.948.180,0000	155.028.900.000,0000
2	C2	1.204.800,0000	<=	1.204.800,0000	0	10.312.070,0000	0	1.212.337,0000
3	C3	20.665.180,0000	<=	20.665.180,0000	0	438,0000	0	20.717.000,0000
4	C4	1,0364	<=	3.100.000,0000	3.099.999,0000	0	1,0000	M
5	C5	1.506.000,0000	>=	0	1.506.000,0000	0	-M	1.506.000,0000
6	C6	0	>=	0	0	0	-M	0
7	C7	0	>=	0	0	0	-M	0
8	C8	1.435,0820	>=	0	1.435,0820	0	-M	1.435,0820
9	C9	0	>=	0	0	0	-M	0
10	C10	1,0364	>=	0	1,0364	0	-M	1,0364
11	C11	0	>=	0	0	0	-M	0

(Source: Author, 2025)

The results of L&IP are shown in table 4.48 above. According to the results, the value of decision variables X1, X4 and X6 are Kshs 1,506,000.0000, Kshs 1,435.0820 and Kshs 1.0364 respectively. It means that it is viable to produce 1,500,000 of tree seedlings,

establish 500Ha of commercial farm forests and rehabilitate and maintain 62 Km of forest roads. The other variables X2, X3, X5 and X7 are not economically viable based on the parameter value of the objective function and constraints. The results also show that the reduced cost of these activities X2, X4 and X6 are Kshs -443,888.0000, Kshs -10,142,660.0000 and Kshs -2,252,280.0000 respectively. It means that if these values are added to the correspondent parameter values on the objective function, these activities will be viable to be implemented. The shadow cost of the other constraints is zero. However, the one-unit changes of this constraints do not affect implementation of these activities. The slack variables introduced into the linear constraints of LP were identified as positive for candidate solution, and therefore the particular constraints were non-binding there in the model, as constraints do not restrict the possible changes from that point.

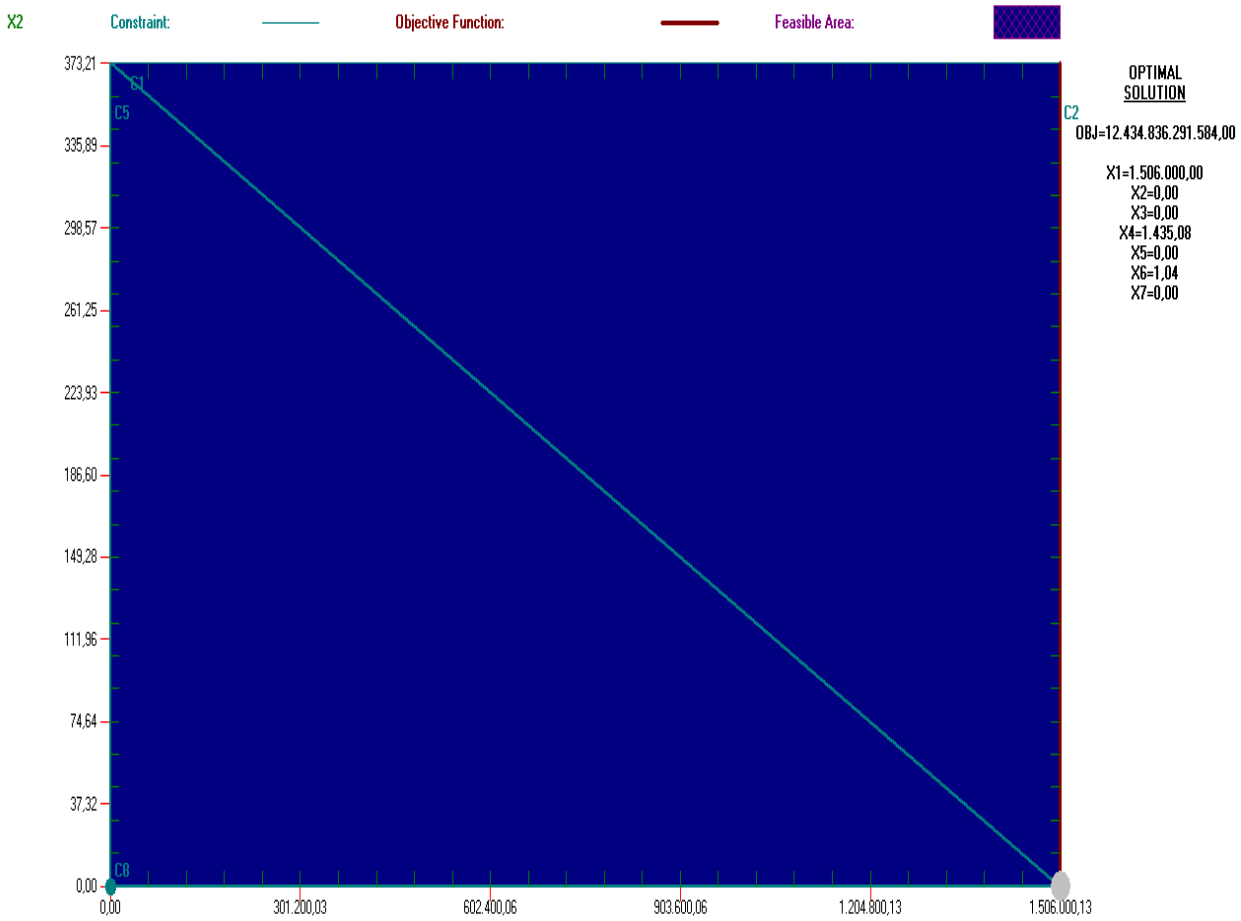

Figure 4.26: Graphical solution of LP model 16 showing feasible region

(Source: Author, 2025)

Figure 4.26 above of Graphical solution of LP model 16, the results show the visualized region shaded providing an optimal solution with objective function value of maximization equals to Kshs 12,434,836,291,584.00 with X1 equals to Kshs 1,506,000.00, X2 equals to Kshs 0.00, X3 equals to Kshs 0.00, X4 equals to Kshs 1,435.08, X5 equals to Kshs 0.00, X6 equals to Kshs 1.04 and X7 equals to Kshs 0.00.

The intersecting region in the graph reflects the decision feasible region as a result of plotting the inequalities in the XY graph. The feasible region provides the optimal solution as well as what all values the model takes in the optimization as shown in the figure 4.26 above. The feasible solution region on the graph is one which is satisfied by the constraints viewed as the intersection of valid region. The optimum point (**.**) at the intersection gives the values of the decision variables necessary to optimize the objective function after subjecting the values of the parameters into the equation of the objective function. This process results in proving the optimal solution of the problem as indicated on the left side of the graph above.

The value of the basic variables keeps transforming to obtain the maximum value for the objective function. The optimal solution is found when all the coefficients in the objective row are non-negative. This means that the LP model clearly provides optimal performance that will lead to lasting output especially allocation of enough fund for better implementation of the activities towards achievement of planned targets.

17. CFC: Meru

Problem statement for feasible models for the AWP&B system optimization for county number seventeen.

a) To produce 1,000,000 tree seedlings with a unit cost of Kshs 5.50 per tree seedling production.

b) To establish 550Ha of plantation with a unit cost of Kshs 22,194.00 per hectare of establishment.

c) To rehabilitate 110Ha of natural forests with a unit cost of Kshs 22,194.00 per hectare of rehabilitation.

d) To establish 200Ha of commercial farm forests with a unit cost of Kshs 14,400.00 per hectare of establishment.

e) To produce 1,000 bamboo seedlings with a unit cost of Kshs 9.00 per bamboo seedling production.

f) To rehabilitate and maintain 62Km of forest roads with a unit cost of Kshs 50,000.00 per kilometer of rehabilitation and maintenance.

g) To determine optimal solution of activities viable to be implemented in the county that minimizes the costs and increases the level of satisfaction of performance.

Table 4.49: LP model 17 optimization formulation and solution

Objective function	
The aim of the objective function is to maximize performance by implementing the six activities in the county while adhering to constraints of raw materials cost, labour cost and machine operation cost due to limited fund allocation. The performance is in terms of the level of activities done.	
MaxZ:5,500,000X1+ 12,206,700X2+2,441,340X3+2,88,000X4+9,000X5 +3,100,000X6 ≥ 26,137,040	
Where; Z is the objective function that should be maximized.	
X1, X2, X3, X4, X5, X6 are decisions variables (The activities to be implemented) which are Tree seedling production, Plantation establishment, Natural Forest rehabilitation, Commercial farm forest establishment, Bamboo seedling production, and Rehabilitation and maintenance of forest roads respectively.	
The coefficient of X1, X2, X3, X4, X5, X6 are the unit cost of the decision's variables for the above activities.	
The objective function is subject to the following constraint equations:	
No	**Constraint equation**
1	Budget constraint: 5.5X1+22,194X2+22,194X3+14,400X4+9X5+50,000X6 ≤ 25,000,000
2	Raw materials cost constraint: 0.8X1+1.6X5 ≤ 801,600
3	Labour cost constraint: 22,194X2+22,194X3+14,400X4 ≤ 17,528,040
4	Machine operation cost constraint: 50,000X6 ≤ 3,100,000
5	Non-negativity constraint: X1, X2, X3, X4, X5 and X6 ≥ 0

(Source: Author, 2025)

Table 4.49 above shows the results of LP model 17 optimization formulation and solution. It provides identified objective function with six (6) decision variables and ten (10) constraints and explicitly states the non-negativity restriction used for writing down the optimization model.

Table 4.50: Results of LP model 17, solved using L&IP software

	17:47:39		Friday	June	07	2024		
	Decision Variable	Solution Value	Unit Cost or Profit c[j]	Total Contribution	Reduced Cost	Basis Status	Allowable Min. c[j]	Allowable Max. c[j]
1	X1	1.002.000,0000	5.500.000,0000	5.511.000.000.000,0000	0	basic	4.562,0000	M
2	X2	789,7648	12.206.700,0000	9.640.422.000,0000	0	basic	2.441.340,0000	M
3	X3	0	2.441.340,0000	0	-9.765.360,0000	at bound	-M	12.206.700,0000
4	X4	0	288.000,0000	0	-7.632.000,0000	at bound	-M	7.920.000,0000
5	X5	0	9.000,0000	0	-10.990.880,0000	at bound	-M	10.999.880,0000
6	X6	39,2192	3.100.000,0000	121.579.500,0000	0	basic	0	27.500.000,0000
	Objective	Function	(Max.) =	5.520.762.000.000,0000				
	Constraint	Left Hand Side	Direction	Right Hand Side	Slack or Surplus	Shadow Price	Allowable Min. RHS	Allowable Max. RHS
1	C1	25.000.000,0000	<=	25.000.000,0000	0	62,0000	23.039.040,0000	155.023.000.000,0000
2	C2	801.600,0000	<=	801.600,0000	0	6.874.574,0000	0	1.086.831,0000
3	C3	17.528.040,0000	<=	17.528.040,0000	0	488,0000	0	19.489.000,0000
4	C4	39,2192	<=	3.100.000,0000	3.099.961,0000	0	39,2500	M
5	C5	1.002.000,0000	>=	0	1.002.000,0000	0	-M	1.002.000,0000
6	C6	789,7648	>=	0	789,7648	0	-M	789,7648
7	C7	0	>=	0	0	0	-M	0
8	C8	0	>=	0	0	0	-M	0
9	C9	0	>=	0	0	0	-M	0
10	C10	39,2192	>=	0	39,2192	0	-M	39,2192

(Source: Author, 2025)

The results of L&IP are shown in table 4.50 above. According to the results, the value of decision variables X1, X2 and X5 are Kshs 1,002,000.0000, 789.7648 and Kshs 39.2192

respectively. It means that it is viable to produce 1,000,000 of tree seedlings, establish 55Ha of forest plantation and rehabilitate and maintain 62Km of forest roads. The other variables X3, X4, and X5 are not economically viable based on the parameter value of the objective function and constraints. The results also show that the reduced cost of these activities X3, X4 and X5 are Kshs -9,765,360.00, Kshs -7,632,000.00 and Kshs -10,990,880.00 respectively. It means that if these values are added to the correspondent parameter values on the objective function, these activities will be viable to be implemented. The shadow cost of the other constraints is zero. However, the one-unit changes of this constraints do not affect implementation of these activities. The slack variables introduced into the linear constraints of LP were identified as positive for candidate solution, and therefore the particular constraints were non-binding there in the model, as constraints do not restrict the possible changes from that point.

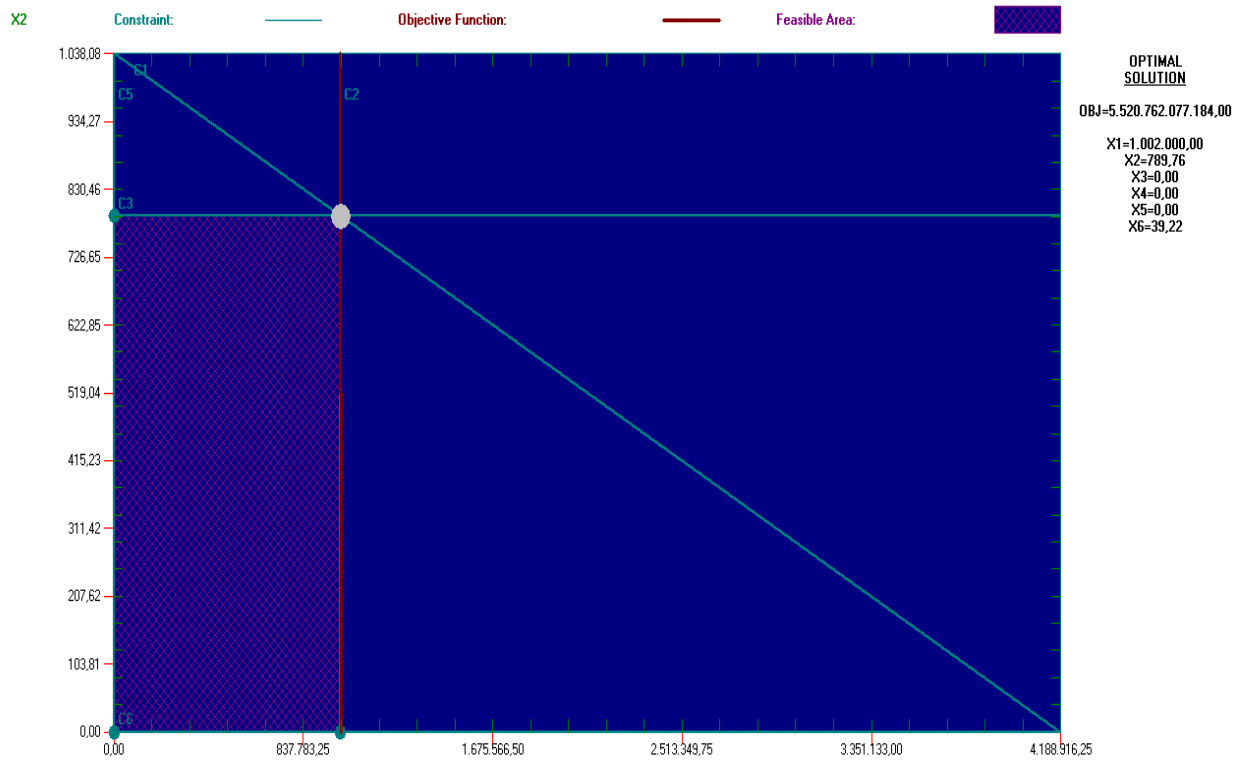

Figure 4.27: Graphical solution of LP model 17 showing feasible region

(Source: Author, 2025)

Figure 4.11 above of Graphical solution of LP model 17, the results show the visualized region shaded providing an optimal solution with objective function value of maximization equals to Kshs 5,520,762,077,184.00 with X1 equals to Kshs 1,002,000.00, X2 equals to Kshs 789.76, X3 equals to Kshs 0.00, X4 equals to Kshs 0.00 and X5 equals to Kshs 0.00 and X6 equals to Kshs 39.22.

The intersecting region in the graph reflects the decision feasible region as a result of plotting the inequalities in the XY graph. The feasible region provides the optimal solution as well as what all values the model takes in the optimization as shown in the figure 4.27 above. The feasible solution region on the graph is one which is satisfied by the constraints viewed as the intersection of valid region. The optimum point (**.**) at the intersection gives the values of the decision variables necessary to optimize the objective function after subjecting the values of the parameters into the equation of the objective function. This process results in proving the optimal solution of the problem as indicated on the left side of the graph above.

The value of the basic variables keeps transforming to obtain the maximum value for the objective function. The optimal solution is found when all the coefficients in the objective row are non-negative. This means that the LP model clearly provides optimal performance that will lead to lasting output especially allocation of enough fund for better implementation of the activities towards achievement of planned targets.

4.4.4 Formulating AWP&B structure to ensure effective and efficient and to negotiate for more funds from exchequer and enable attainment of PCs target by CFCs

Data analysis of the results of formulation of AWP&B showed that it will not be effective and efficient to negotiate for more funds from exchequer and enable attainment of PCs target by CFCs using the current AWP&B formulation. This study identified weaknesses/short comings of the current structure of AWP&B which depicted short fall within the context of preparation and planning phase. The CFCs are expected to enhance efficiency, effectiveness and economic delivery of goods and services. They are required to deliver more outputs and outcomes with minimal financial resource availed to them to run their planned activities to enhance sustainability and affordability. However, the results analysis on the performance satisfaction on planned activities implemented by the CFCs indicated a fluctuation effect of production of goods and services.

The results of the performance of implemented activities showed that their program performance target had a short fall of not being Specific, Measurable, Attainable, Realistic and Time bound (SMART) as required as a basis for fund negotiation. The figure 4.28 below indicates a potential feasible model of AWP&B planned activities where funding gaps that bring fluctuation in planning and budget has been assumed to be constant providing a steady increase in budget. In the model the system essentially seeks out to minimize the total fixed and variable costs to the work performance of the CFCs planned activities.

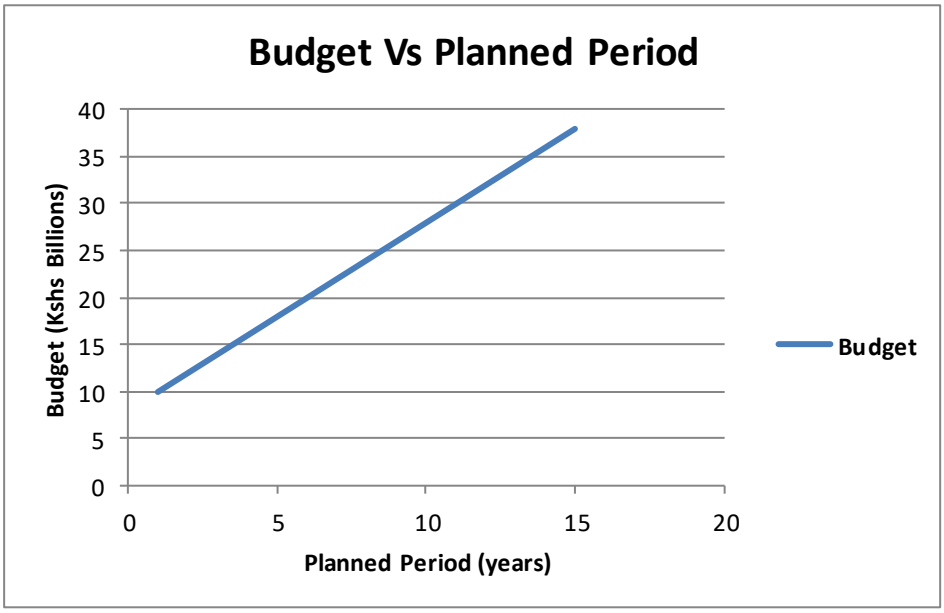

Figure 4.28: Feasible model of AWP&B

(Source: Author, 2025)

Whatever the context, the negotiation was found to be a competitive or collaborative one that requires a typical procedure.

The figure 4.29 below shows a typical identified procedure of negotiation framework path of AWP&B preparation that defines the problem by eliminating irrelevant clutter and clarifies the path towards negotiation goals enacted by the treasury to be enhanced.

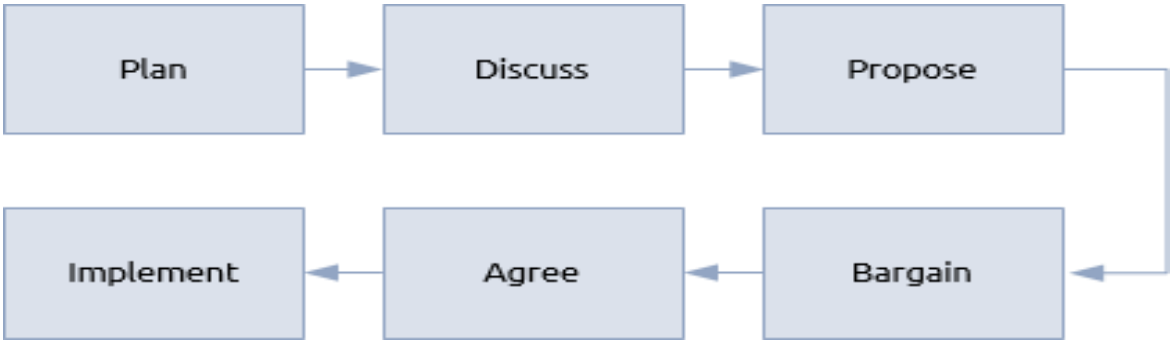

Figure 4.29: Negotiation framework path of MTB process

(Source: Guidelines for finalizing the estimates for the FY 2021/22 and the MTB: The National Treasury and Planning Circular No.3/ 2021)

The negotiation framework path results are illustrated below;

Plan: Prepare thoroughly AWP&B; setting goals for the outcomes and agreeing on an escalation route if the negotiation for fund is not adequate;

Discuss: Set the scene, identify the key issues in the organization and communicate the objectives, listen to questions and feedback regularly to confirm understanding for any weaknesses/short coming;

Propose: Propose a solution that is clear and unambiguous;

Bargain: Discuss the proposal; communicate the AWP&B planned activities to be implemented in the medium-term and areas of flexibility to achievement;

Agree: Reach agreement on the core issues; document what has been agreed and record any peripheral, outstanding items with timescales for resolving them and;

Implement: Communicate the outcome of the negotiation as necessary, update any related management documentation.

The analysis of results in negotiation framework showed that it is easy to get wrong and that the cardinal sin is to enter into negotiations unprepared. The study noted that this can easily lead to mistakes such as making opening offers that are clearly unacceptable to the other parties. Pressure to conclude negotiations and get on with the project or programme can result in rushed discussion that produce outcomes which are difficult to implement.

The table 4.51 below shows the amalgamated AWP&B of KFS and the table 4.52 shows the results of a formulated AWP&B that will be effective and efficient to negotiate for more funds from exchequer and enable attainments of PCs targets by CFCs. The formulation of the AWP&B was found to be cost effective and sustainable to support delivery of outputs and outcomes within a tight fiscal environment. The MTB negotiations anchored on MTP of the vision 2030 are built on the AWP&B results on the progress made in the three previous FY termed in the context of MTB strategy as documentation of PPRs for fund consideration. It was also noted from the results that for prescribed feasible model for the AWP&B for the system optimization to be realized as planned and budgeted against SP targets of the FFYs, the formulated AWP&B benefits

should allow other things to change accordingly in ‘‘*Mutatis Mutandis’’* indicating the effect of one economic variable that matter will also change as a result.

Table 4.51: Amalgamated AWP&B structure of KFS

Programme/Project:												
Strategic Objective:												
Outcome in Strategic Plan: Result Area 1: Result Area 2: Result Area 3: Result Area 4:												
1. **Expected Outputs**:												
Activities	**Products**	**Objectively verifiable Indicators (OVI)**	**Means of Verification**	**Person in Charge of the Activity**	**Unit Cost of the activity in Kshs**	**Indicative Budget (Kshs)**			**Implementation Schedule**			
						GoK (Kshs)	**Others (Kshs) -(e.g. Donors)**	**Total Budget (GOK+Donor)**	**Q 1**	**Q 2**	**Q 3**	**Q 4**
Output 1,												
Output 2;												
Output 3.												
Output 4.												
Total												

(Source: Kenya Forest Service Annual Work Plan and Budget, 2024)

Table 4.52: Formulated AWP&B structure

Programme/project: xxx							
Strategic Objective: xxx							
Result/outcome in Strategic Plan		**Strategies**		**Expected outputs**		**Key Performance Indicator (KPI)**	
<State the Result Area (s)/outcome (s) in the Strategic Plan that you will contribute to during the planned fiscal period>		<Identify the Strategy (ies) you will adopt to achieve the stated outcomes>		<List the outputs here>		<Provide the KPI here for each of the outputs> 1. xxxx 2. xxxx 3. xxxx	
Activity	**Timeframe**	**Tasks**	**Responsibility**	**Means (input)**	**GOK (Kshs) Funding**	**Others (Kshs) e.g., Donors**	**Total Budget allocation (Kshs)**
(Describe the action/activity in short and precise statement)	(Indicate which quarter the stated action will be done)	(An activity has several sub-actions or tasks for it to be completed. Indicate the tasks to be performed to complete the planned activity)	(Whose responsibility is this activity? Indicate the person who leads and should submit reports on the implementation of the activity)	(For each activity provides the inputs required to implement)	(For each activity provide GOK allocated Budget to implement)	(For each activity declare available/additional funding to implement**)**	

(Source: Author, 2025)

Table 4.53 below shows the results of 10 potential characteristics established by the study that contribute to efficient and effective AWP&B formulation with the ‘‘*availability of funds for immediate use*’’ rating at the top as determinant support to the planned activities lined to be implemented.

Table 4.53: Potential characteristics for efficient and effective AWP&B processes

Rank	Influencing factor for efficient and effective AWP&B
1	Availability of fund for immediate use
2	Attainable planned activity targets for the set goals and objectives
3	Good state of activities with a guiding process for implementation
4	Favorable environment conditions for attainment of optimal results
5	Needs and objectives of the sector in place
6	Availability of required resources for organization to run effectively
7	Accessibility of locality of site to carry out the activity
8	Sound socio-economic status benefits of the enterprise to local community
9	Focused social responsibility of the implementer
10	Availability of personnel for efficient productivity

(Source: Author, 2025)

From the analysis of formulated AWP&B that will be effective and efficient to negotiate for more funds from exchequer and enable attainment of PCs target by CFCs, the study established the following Medium-Term Development Strategy Framework that support MTB to resolve the problem of fund allocation to programmes;

a) MTB negotiations anchored on MTP of the vision 2030 and built on the progress made in the three previous financial years termed as PPRs;
b) The government addresses the policy, legal framework, regulatory and governance challenges as a priority to ensure that the negotiated fund to run planned activities are adequate and timely disbursed to programmes;
c) The government development ‘‘Agenda’’ are prioritized by programmes either as drivers or enablers in preparation of their AWP&B to withstand the threshold of consideration of adequate resource allocation in the MTB negotiation;
d) The prepared AWP&B by programmes are cost effective and sustainable;
e) The government strongly enhances the fiscal policy measures in place to address the perennial inadequacy of disbursement of fund to programmes to run their planned activities.

The results of the study established the following challenges that hinder effective negotiation of funds;

a) Individual parties are not ready to understand the other party at all;
b) Lack of time for effective negotiation;

c) Going unprepared for negotiation;
d) Lack of patience leads to a bad negotiation;
e) Criticism, sarcasm, derogatory remarks made by an individual party or other parties;
f) Last minute changes;
g) Being too rigid and;
h) Lack of confidence

Content of the established data were descriptively analyzed which confirmed the following challenges faced by the parties involved in the negotiation process;

The study noted that when individual party is not ready to understand the other parties at all it brings an effect on the outcome of the negotiation. These are individual parties who only think about their interests and tend to ignore the interest and needs of other parties. Try to find the expectations of the other party as well. For funds negotiation, you will definitely be appreciated if you strike a deal to get funds to your organization but remember the other party also requires to be given funds.

The analysis draws on lessons from inefficient time allocation for negotiation process confirmed that it results to an ineffective negotiation where party problems are finalized in a hurry. The rule of thumb in a negotiation forum is that one should never be in a hurry to close deal of resource allocation with the treasury team. Analysis of the proposed

AWP&B structure by programme is to be done carefully by the parties and then come to conclusions when all expectations have been solved. The process requires enough time.

Going unprepared for negotiation results to a challenge for an effective negotiation. Don't underestimate the second party in the negotiation. One should do his homework carefully. Check out even the smallest details before going for a negotiation. Don't think that the other person is not a smart as you. You need to have valid answers for his questions.

The study established that lack of patience leads to a bad negotiation. Every individual party has the right to express his views and one should not interfere. You might not agree with other people's party but at least listen to them. Sit with the other parties and make them realize how the deal would benefit you as well as them. If possible, take a note pad and pen with you to explain things in a better way. Carry all the necessary documents which you might require at the time of negotiation.

The study noted that criticism, sarcasm, derogatory remarks are threats to an effective negotiation. Never ever say anything which might hurt others. Remember everyone is here to negotiate to be given fund to run their planned activities, so be logical and justified. Don't get too involved and over emotional. One should be a little diplomatic and intelligent for an effective negotiation.

The study noted that last minute changes results to wrong conclusions and misunderstandings. The two parties must be very clear on what they expect from each other, and must stick to it. The programmes should not change statements every now and then. Once a conclusion is reached or a deal is cracked, it's always better to sign an agreement in presence of both the parties.

The study noted that being too rigid is a challenge to an effective negotiation. Be a little flexible. Compromise to your best extent possible and don't crib always. One should adopt a positive attitude and try his level best to adjust with each other and find out a solution which will satisfy all.

The study noted that lack of confidence is a threat to negotiation. Don't forget to make an eye contact with the person sitting on the other side of the table. It's important to be serious but that does not mean you will not even greet the other person. Be straightforward and crisp in your communication. Take care of your dressing and appearance as well.

Results of the established opportunities;

a) The structure strategy in negotiation describes the way the programmes offer their proposal that strongly affects how the others view them;
b) The structure strategy stresses what the other party would gain rather than lose is an important form of framing in negotiation;

c) The structure strategy enables the negotiator think positive, prepare, think about the best and worst outcome before negotiation, articulate issues and build value, give and take and;

d) Structure strategy is a result of historic development working from the past review (PPRs) and it has opportunity to balance different interest of groups with different programmes.

CHAPTER FIVE

DISCUSSION

5.1 Introduction

This chapter presents the discussion of the analysis of AWP&B processes on performance of CFCs in Kenya based on results. Section 5.2 discusses descriptive results by comparing and giving contrast of research findings with previous findings to determine whether there were any consistencies/inconsistencies and providing explanation where necessary. Section 5.3 discusses empirical results for each of the specific objective under subsection 5.3.1, 5.3.2, 5.3.3 and 5.3.4. The discussion is aligned systematically to the output results of the specific objectives in chapter four and provides possible forest policy applications that can inform to answer the research questions in the study.

5.2 Descriptive discussion

The database used comprises of 100% response rate from 17 CFCs out of 47 who were administered with one questionnaire on implementation of AWP&B processes of one financial year. The core objective for which the questionnaire was drawn up was to analyze the impact of AWP&B processes on performance of the CFCs and interpret the findings, connect them to literature, and highlight the study's significance. To that end, the questionnaire was divided into 12 major activities done in the field by CFCs that required financial support from the exchequer. The study established that for better work performance by the CFCs where activities in the work plans are achieved there should be

facilitation of better service provision, more efficient use of resources, more targeted use of the fund and greater accountability for policy implementation.

The study revealed that there exist significant disparities in AWP&B processes delivered by the public organizations brought about by inadequate fund released to implement the activities. To that effect the organizations do not fully achieve the implementation of their activities as planned in their AWP&B processes. This deficit of financial resources necessitates a strong enabling AWP&B structure to enhance negotiation of more funds from exchequer. One glaring issue is that the allocating committees of treasury may not prioritize the activities of the organization highly and thus may allocate very little funds. Meanwhile, as all Government organizations vie for the same 'basket of funds', there is need for strong presentation to ensure enough funds are given to the organization. Therefore, the delivery of AWP&B processes in organization require rational decision and acquire potential solutions factors associated with procedures and structures for acceptable AWP&B processes for funding.

The univariate statistical analysis of primary data measuring the ability of KFS performance using three categories of ranking ''very satisfied (3), satisfied (2) and not satisfied (1)'' revealed that the observed calculated $\chi 2$ test statistics was greater than the critical value (5.99) determined by the level of significance (0.05) and the degrees of freedom. This significant results from the analysis depicts short fall of the implementation of AWP&B processes by the organizations. However, the organizations

can improve on their service delivery on AWP&B processes and enhance their achievement when key performance activities indicators are well planned and budgeted. It is noted that reforms in the public sector have entailed multiple work performance improvement including the modelling of the applicable systems structures.

Correlation between funds allocation and performance of different activities using LP model revealed that there was a strong link to budget gap and allocation that affected the performance of the organizations. The affected activities included tree seedling production, plantation establishment and Bamboo seedling production which were very sensitive to budget gap. The study also revealed that overall performance was not time or activity dependent implying that performance was relatively uniform across the time period for the different activities. The significant correlations noted between performance, budget gap and budget allocation lend credence to the observations in the LP model that some activities presented strong ties between the dependent variable and the two predictors. The specific analysis of impact of AWP&B processes using LP model for optimization appears to have attributed to regulated distinct patterns that were generally reflecting the apparent improvement on work performance. The pattern however appeared to be affected by irregular fund allocation to the organizations for the implementation of the planned activities.

Improved AWP&B structure was seen as a key enabler in realization of the performance of the KFS strategic plan objectives and able to provide services in priority areas in the

organization efficiently and effectively to meet society's needs in a way that it conserves and maintains forest ecosystems for present and future generations. Therefore, it is important to come up with a feasible model of AWP&B. The implementation of the feasible model of AWP&B must be supported by the potential characteristics to resolve the problem arising in the MTB process for resource allocation to programmes. However, the negotiations are vulnerable, unless they are protected by procedural framework strategies that are to be followed by the parties involved (GOK, 2021). Thus, there is need to put in place appropriate and improved AWP&B to be implemented in the work place and incorporate a clear set of strategic vision for operational purposes. As a step forward, it also calls for redesigning of proper guidelines on development of AWP&B for the forest sector and other institutions to follow to enhance their respective work planning and budget for work performance improvement.

5.3 Empirical discussion

The empirical discussion interpreted the results to bring out the implication of the research and establish the significance of the study. The discussion is aligned systematically to the output results of the specific objectives in chapter four and provides possible forest policy applications that can inform to answer the research questions in the study.

5.3.1 Conformity of the amalgamated AWP&B of KFS to requirement by the treasury guideline as stipulated in MTB process for funds allocation from exchequer

Linking forest policy implications of the Government, work plan and budgeting from the results the study found that there are requirements by the treasury guidelines as stipulated in the MTB process for funds allocation from exchequer involved in the delivery of AWP&B processes by organizations. The study established that for better work performance where activities in the work plans are achieved there should be facilitation of better service provision, more efficient use of resources, more targeted use of the fund and greater accountability for policy implementation. However currently there exist significant disparities in AWP&B processes delivered by the public organizations that require government policy interventions. To this effect there is need to establish clear policies, ensure that budget reflect those policies and the spending is in line with allocation of fund, and the need to measure results for the organizations to conform with the treasury guidelines. As observed in the literature by Ugbogbo and Abioluwajumi (2019) there is need to constantly improve AWP&B performance KPI for the government to properly articulate the resources to commitment towards efficient service delivery, organize areas of policy priorities, determine the amount to borrow to finance approved spending to enhance improvement of the country's economy and the general welfare of her citizen.

The employed analysis to establish the impact of AWP&B processes on performance consistency concurred with the trend suggested in the studies by various researchers (Zulfigar *et al.,* 2017). The impact of AWP&B processes optimization on work performance necessitates assessment evaluation of the existing applied system on work performance. Based on the current performance, the study established a number of short falls in conformity in delivery of the current amalgamated AWP&B processes of KFS. This however differs with the intended theory of the policy application made at the national level.

Referred literature by Zulfigar *et al.* (2017) explored the impact of managerial and adaptive capabilities to stimulate organizational innovation in her work planning and empirically proposed a rigorous model for the positive impact of managerial and adaptive capability. The study found that the applied well-structured work planning and budget helped to develop and improve the performance of organization. Although these studies show attribution in line with the research question ‘‘How do the amalgamated AWP&B of KFS conform to requirement by treasury guideline as stipulated in MTB process for funds allocation from exchequer?’’ with the identified requirements, the trend does not prove to realize good delivery of the policy process mechanism despite seen as a useful integral tool for proactive decision making and is termed by innovation as the impact of managerial and adaptive capability.

According to diagrammatic conceptual framework the AWP&B process with the delivery of the policy process mechanism in the organization is aligned with government policies involving vision 2030 and constitution of Kenya, 2010. The label illustrates the drivers of the impact of AWP&B processes optimization on performance in KFS as a corporate organization.

The corporate organizations plan and prepare their budget and outlines medium priorities and corresponding resources in line with MTP of the Kenya vision 2030 and national agenda provided as found in the trend in characteristics towards the outcome of the policy. The KFS as a public forest sector organization with priority to achieve its AWP&B processes is guided by government policies including vision 2030, constitution of Kenya (GOK 2010), Forest Conservation and Management Act 2016 (GOK, 2016), Forest Policy (GOK, 2006), National Forestry Programme (GOK, 2016), Forest Management Plans (FMPs).

The results of the assessment of these drivers on the analysis of impact of AWP&B processes suggest that they contribute to the delivery of the system optimization on work performance by the KFS organization. The findings of the impact of AWP&B processes implication on forest policy process mechanism indicated that the delivery of the national policy process ensured clarity of policy direction and KFS framework on SP which are consequently implemented by CFCs. The organization SP provides the road map for forestry development through the implementation of MTP. In line with the SP and

compliance with the requirements for devolution, the KFS streamlines and implements its programme with a view towards achieving the 10% forest cover by 2030 and 30% tree cover by 2032 (KFS, 2023).

The MTP prepared at the national level results to preparation of MTEF that guides the Government in the provision of printed estimates released quarterly to the implementers. The framework ensures that spending is consistent with approved budget from the Government and results measured through implementation of performance evaluation that ensure feed back into the policy process mechanism. As referred by literature on section 36 of the Public Finance Management Act, 2015, (GOK, 2015) a guideline is provided on the processes and procedures for preparing the MTB process which apply to all public sector organizations and it's prepared within the context of a moderate global economic recovery. The MTEF budget provides an enabling environment for the private sector to thrive by preserving macroeconomic stability; expanding infrastructure; improving security; implementing business regulatory reforms; expanding access to finance and instituting governance reforms. Each and every individual of the public sector are to bring on board their plan and budget for negotiations for funds provision to enable their SP full implementation.

The delivery of mechanism of AWP&B processes is thus considered as a useful tool for proactive decision making. However, key to the success of the plan is the ability of the organizations to mobilize the required resources. The results from the three SPs FFYs

provides estimates of funds required to implement the SPs over the planned period and reflects potential sources of funds and funding gaps. The KFS SP provides outcome depicting impact of AWP&B processes. This phenomenon is supported by the results in the budgetary requirement for SPs implementation for FFYs 2010-2014, 2014-2017 and 2017-2022 which shows a trend increase with fluctuating percentage of 53% and 11%.

The fiscal budget for the FY is prepared in accordance with Article 201 of the Constitution of Kenya (GOK, 2010). The referred literature shows that National Treasury invites the general public, institutions and the private sector to submit proposals on economic policy measures that the Cabinet Secretary for the National Treasury could consider in preparing the FY budget. These proposals consider measures that will spur economic, create employment opportunities and reduce poverty. The finalization of the budgets to be considered in the printed estimate is realized through level of approach of reconciliations with commitments of negotiations process justifying the submitted AWP&B proposal (Hans, 2015). As showed in the literature by GOK (2010) the justification is pegged on measures including creating a business environment which is conducive, deepen structural and governance reforms, and improve security in order to encourage innovation, investment, growth and expansion of economy and employment opportunities among others.

The analyzed impact of AWP&B processes on performance that has resulted with the funding deficits provides leeway to review the budget at the national policy level.

However, the reconciliation of this impact of AWP&B processes at every level is viewed as negotiation process in the strategic plan interaction between the players in a situation containing set rules and outcome. Hans (2015) literature on the aspect suggests that organization structures, programmes and practice are adopted for the purpose and thereby augmenting the limits of the more rationalistic explanation of decision making.

The end product of the delivery of policy process mechanism is the attainment of results which is a corporate social responsibility by corporate managers where goods and services are produced by employee often measured by objectives or standards (Okpara & Idowu, 2013). However, in the literature by Koril *et al*. (2015) suggested that these results can be fast tracked in the PCs stipulating specification of the mutual work performance obligations, intentions, responsibilities and agreed AWP&B activities targets for the FY between the two contracting parties. Therefore, the PCs must be further integrated within the wider management activities to ensure it is part of the organization long-term objectives and goals to enhance work performance in the public sector.

The delivery of AWP&B processes in corporate organization was found to require rational decision and acquiring new potential solutions factors associated with procedures and structures to prepare acceptable planning and budget report. These contributing invested factors are as a result of impacts that influence organization to adopt change of doing business from the norm of doing business as usual. The results from the study showed that these change that will move the organization readiness to adopt improved

modeled AWP&B optimization to be applied by national level budgeting team in the process of negotiation and reconciliation for fund allocation from exchequer.

The findings from the study showed that AWP&B delivery policy making process commence with national policy deliberations that ensure clarity of policy direction and provide AWP&B framework for the strategic planned activities to be implemented. The second level of the delivery policy making process is the negotiations and reconciliations of the budget which the study showed that it is used by corporate managers as basis to prepare AWP&B in line with corporate SP activities of the FFYs. The third level of delivery policy making process the study found that it is at the point of expenditure management that ensures that spending is consistent with approved budget from the government. However, this expenditure is subjected to evaluation of financial status of corporate organization from time to time by internal and external auditors to keep in toes with accountability. The end delivery of policy making process was found to be the results that enable recipient improve expenditure resource management on work performance and is measured through evaluation to ensure a feed back into the policy making process mechanism for another cycle level of approach of negotiations and reconciliations.

Prior tasks of the delivery of AWP&B processes for fund allocation negotiation the study identified; reform's priority reconciliation of budgets and plans involving sector working group's negotiations, preparation of long-range plans and budgets and follow a definite

budget procedure and implementation methodology and shorter budgeting cycles preparation in the MTEF as the requirements needed by organizations to follow. The study identified; assumptions underpinning the MTB process fiscal framework, priorities of the activities to be implemented in the FFYs, form and content of budget to be negotiated for allocation, vote and programme budget Ceiling of the activities to be funded and PPRs of AWP&B activities implemented. However, the hurdles of the AWP&B delivery policy making process are affected by inefficiency in implementation. The problem of bad performance can be resolved through comprehensive reforming the policy making process and legislative act to enable development of a strong framework strategy that will take the CFCs performance to the next level in terms of activities implementation and work performance.

5.3.2 The performance of CFCs against the PCs targets as indicated in their AWP&B

The in-depth evaluation survey revealed that AWP&B implemented by the CFCs is mostly a formal process. However, the strategy implementations do not meet the threshold of the planned activities action plan because of fund deficit and the impact assessment results confirmed depicting significant gaps reflecting variances in budget allocation that exists on the amalgamated AWP&B of KFS. Therefore, if AWP&B processes is formalized to support laid down procedures and guidelines for estimates of MTB set by treasury for fund allocation, it will meet the required threshold of the AWP&B processes planned activities action plan. The respondent revealed that the top

management participates in preparation of AWP&B and the execution of the strategy is seen to be the responsibility of middle and lower managers with assistance of the employees. The researcher therefore argues that the use of evaluation survey tool on AWP&B can provide the CFCs more effective means for improved strategy formulation.

The results of the evaluation survey on performance of the field activities consistency showed a trend of a systematic and continuous collection, analysis and use of information for management control and decision-making, hence, an integral part of day to day to fast-track management of cost centre. Whereas, evaluation showed a consistency trend of systematic assessment and objective of ongoing or completed projects, programmes or policies, its design, implementation and results.

The survey was found by study to be interactive and mutually supportive processes that provided management with better means for learning from past experience, improving service delivery, planning and allocating resources, and demonstrating results as part of accountability to key stakeholders. Application of univariate statistical analysis of primary data from evaluation results towards measuring the ability of KFS performance using three categories of ranking ‘‘very satisfied (3), satisfied (2) and not satisfied (1)’’ showed that the observed calculated χ^2 test statistics is greater than the critical value (5.99) determined by the level of significance (0.05) and the degrees of freedom. The χ^2 test statistics was found to be significant depicting funding gaps that exist on the application of the use of current budget as a planning and control tool for management to

realize expected results. The absence of strong enabling system framework to negotiate for adequate fund from exchequer contributed for underperformance of the CFCs to fully implement their prepared AWP&B. As indicated by literature in GOK (2018) the strategic challenges realized by organization not meeting the PCs targets as indicated in their AWP&B necessitates the undertaking of Rapid Results Initiative (RRI) in order to fast-track implementation of projects and activities. This is a performance management criterion designed to enhance efficiency and effectiveness in service delivery and it seeks to minimize the total fixed and variable costs to the performance of the organization activities.

The economic evaluation of AWP&B processes assumed that the system had some funding gaps in its application to realize the expected results. In essence the AWP&B processes may incur short falls in the process of implementation that negates the mission of achievement of the planned activity targets. However, as Lemmens *et al.* (2006) noted in the literature inefficient systems should be perceived as an opportunity to improve instead of a weakness. The study found that the current structure of AWP&B processes still has funding gaps due to poor planning and implementation of the policies. The design of the research survey means that existing applicable strategy should be optimized to promote good delivery of the resource to enhance realization of the expected results as suggested by a literature by Kimondo (2010).

The study on evaluation of the performance towards implementation of AWP&B processes seemed to suggest that the system need to be enhanced to realize improvement on work performance in order to achieve strategic plan targets of the FFY. The evaluation analysis on performance results might suggest answering research question ‘‘how do the CFCs perform against their PCs targets as indicated in their AWP&B?’’. According to literature by Okpara and Idowu (2013) the corporate managers have sole responsibility to spear head the attainment of their station’s performance achievement with the scarce resources available. The corporate managers are aware that they will not be judged by their stakeholder only on the basis of their financial performance failure but also by their employer. Thus, constraint of impact AWP&B processes application in the process of work implementation should not be viewed as a limitation to achievement of work performance.

The study noted that there are factors influencing the AWP&B processes enhancement for sector work performance improvement. The system specifies strategies to be undertaken, resources required; stakeholders that will be co-opted and necessary improvement in order achieve strategic objectives of the organization. It is the process by which an organization estimates its finances for a future period and plans its operations accordingly (Koening, 2005). The AWP&B processes enhancement for the sector performance is influenced by some factors realized in the study. These factors provide a set of guidelines for top management to describe each department’s role in achieving goals and objectives in the corporation (Gubbins, 2003). In the referred literature by ADB

(2012) content analysis of impact AWP&B processes it found out that the influencing factors is where real performance improvement can be found in the choices, decisions and resource allocations made by the top management.

The CFCs depended heavily on implementation of AWP&B to execute the management of resources in order to attain the achievement of work performance in the FFYs. The revolving change of circumstances from economic point of view necessitates for an assessment of the applied system to evaluate its impact on work performance. Past efforts of the CFCs in the study areas were made to improve the management of resources with the available allocated resource fund. These included: control over the planning and budget, keeping focused on planning and budget goals, aware on what is going on with their planning and budget, organizing spending and savings properly, deciding in advance how their planning and budget will work for them, save for expected and unexpected costs, provides early warning for potential problems, determine request for subsidiary fund and how much and produce according to their target.

Despite aforementioned number of factors identified by the study to be contributing to improvement of work performance, the system application is overlooked and received little recognition and, in most organization, AWP&B processes fail to give a competitive edge as planned as referred in the literature in Lemmens, *et al.,* 2006. The findings by literature by Kimondo (2010) in attempt to optimize indigenous *Vitex payos* as a dryland resource in Kenya showed that the communities in the areas had local use practices that

sustainably used natural resources and effectively conserved biological diversity. The local communities overlooked and received little recognition of the innovated system of optimization to enhance production of the indigenous Vitex payos as a dryland resource in Kenya despite its accrued benefits on production. However, Kimondo (2010) noted that as a result of increased human and livestock population pressures, the productivity and sustainability of dryland agriculture had declined thereby making the local communities resorting back to earlier option of optimization of the resource to improve performance on production for their own benefits. However, during this study it was established that optimization tended to be dynamic. This observed phenomenon was attributed by the problem of underfunding of the proposed AWP&B and this resource allocation with funding deficits resulted to the CFCs not realizing the expected achievement planned activities of the FFYs.

The inputs and outcome of the AWP&B processes implementation the study found out that there were not realized as expected. However, the study showed that corporate managers had the responsibility to deliver and be able to achieve the work plan activities with the provided budget. Corporate social responsibility emphasized in the study that corporate managers of today were too aware that they will not be judged by their stakeholders only on the basis of their financial performance. Since the economic responsibility of a business was to produce goods and services that the society desires and sell them at a profit, the corporate managers had sole responsibility to identify its stakeholders and incorporate their needs and values within the day-to-day decision-

making process to enhance work performance. The study found out that public sector institutions can improve on their service delivery process and enhance their achievement when key performance activities indicators are well planned and budgeted. It is noted that reforms in the public sector have entailed multiple work performance improvement including the modelling of the applicable systems structures.

The nine factors end results were identified to be influencing the enhancement for sector work performance improvement. These factors included the following; gives you control over the planning and budget, Keeps you focused on planning and budget goals, makes you aware what is going on with your planning and budget, helps you organize your spending and savings, make you decide in advance how your planning and budget will work for you, enables you to save for expected and unexpected costs, provides you with an early warning for potential problems, helps you determine if you can request for subsidiary fund and how much and enables you to produce according to your target. These influencing factors end results in the public performance therefore are attributable to work performance improvement initiatives through varying degrees.

If these challenges are not addressed, they may turn into a significant fiscal risk to Kenya's economy and affect the contribution to GDP. These were identified field activities implemented by CFCs but inadequately funded; Tree seedlings, Plantation establishment, Natural forests rehabilitation, Farm and dryland forestry programme, Bamboo establishment, Partnership with private land owners, Transition implementation

plans, Rehabilitation and maintenance of forest roads, Ecotourism, way leaves and installations, Silvicultural treatment, Refurbishment of rangers housing and Revenue collection.

5.3.3 Correlation between funds allocation and performance of CFCs

Data analysis applied LP models to determine the appropriate budget that need to be allocated to the activities implemented by CFCs in order to achieve their planned targets. The LP is a method to achieve the best outcome such as a maximum profit or lowest cost in mathematical model whose requirements and objectives are represented by a linear relationship.

The empirical results showed allocations of outputs targets for different activities and budgets across for the activities implemented by the CFCs inefficient in the absence of optimal budget allocation. The equations were derived for the model to show interaction of funds allocation and performance in terms of the level of activities done. The LP formulation examined the impact of AWP&B processes on performance of the CFCs in Kenya. The solutions demonstrated that implementation of AWP&B processes can be expensive, with no simple rules available to describe how implementation of AWP&B processes can be achieved with minimal budget allocated from the exchequer. LP offers considerable promise as an aid to decision making for difficult natural resource management problems. Analysts must recognize, however that decision makers often

consider many factors in addition to those that might easily be specified in a LP model for optimization.

Some of the activities showed a strong link to budget gap and allocation. These included tree seedling production, plantation establishment and Bamboo seedling production. Thus, these activities provide a good opportunity for optimization of budgetary allocation given that they are sensitive to budget gap and the lower the budget gap, the higher the performance. The other activities did not show much sensitivity to budget allocation. It was also established that overall performance was not time or activity dependent implying that performance was relatively uniform across the time period for the different activities. The significant correlations noted between performance, budget gap and budget allocation lend credence to the observations in the LP model that some activities presented strong ties between the dependent variable and the two predictors.

The management of AWP&B processes is a complex activity. However, it is possible to get an optimal solution using LP in AWP&B processes. The LP model is helpful in illustrating the economic between funds allocation and performance which is in terms of the level of satisfaction of performance of activities done. The mathematical model for optimization is developed in terms of the unit costs of these activities. However, the activities implemented by CFCs are to be investigated. This objective function is subjected to different constraints such as budget, raw materials, labour and machine operation costs. The CFCs appreciated that some prevailing circumstances made the

system fail but can be corrected in order to continuously manage the resources sustainably. The study observed that under this circumstance's organization provide for a proposal requesting for a supplementary budget to be used to finalize the implementation of the activities of the FFY which may have not been undertaken in order of priority. Nevertheless, noticeably with envisaged optimization of the system and promotion of its processes, this scenario could potentially change with minimal financial input thereby improving the work performance. The results from this study have shown that the AWP&B processes is amenable to suit the prevailing circumstance with the right order of application. The LP model clearly provided optimal performance that will lead to lasting output especially allocation of enough fund for better protected, conserved and managed forests towards achievement of 15 Billion tree growing campaign by 2032 as envisaged in 15 Billion Tree Growing Strategy 2023-2032; a special presidential forestry programme for landscape and ecosystem restoration (GOK, 2023).

The budget constraint to the system in general remains the poor attitude of conceptualizing the feasible model for the AWP&B framework. The budget constraints limit the choices as a consumer and affect the overall utility. However, economists can still maximize utility given a limited budget and come up with a policy application for a sustainable management for forest resources. Beliefs of maintaining status quo by CFCs acts as a disincentive factor. However, the population structure study, the results showed that AWP&B processes was dependent on the level of implementation of work performance. In situation where there was low achievement compared with the planned

targets, the study showed that there was lack of resource allocation to enable the CFCs succeed to meet the expected results of the implemented planned activities.

As propounded in the research conceptual framework of the study the system suggests understanding of research problem exploration, the specific direction the research will take and the relationship between variables in the study. The introduced division of decision making from activity planning level to government policy planning provided a meaningful approach for analysis for a derived correlation between funds allocation and performance of CFCs that establishes the solution of the research question ‘‘What is the correlation between funds allocation and performance of CFCs?’’. Based on the findings in the study the result provides minimized total fixed and variable costs to the performance of the organization activities and subsequently reduces the impediments of underfunding of planned activities in the FY. From the results presented in chapter four, numerous findings emerge from the outcome of the impact of AWP&B processes used. One of the most important outcomes of the research is the identification of gaps the CFCs not getting adequate funds to realize their work plans, strategies and policies. This means that the budgetary requirement by the CFCs to effectively realize their objectives is not provided as requested. The inadequate funding from the exchequer results to under performance by the CFCs.

The result of the study featured a fluctuated budget provided to CFCs. Thus, planning and budgeting as a mechanism control tool for management needs to be enhanced to

influence the effective negotiation of fund. Thus, the study employed optimization model to find solution to funding deficits and essentially seeks to minimize the total fixed and variable costs to the work performance of the organization activities.

The specific analysis of the impact of AWP&B processes using LP model for optimization appears to have attributed to regulated distinct patterns that were generally reflecting the apparent improvement on work performance of the CFCs. The pattern however appeared to be affected by irregular fund allocation to the organizations for the implementation of the planned activities. The studies have demonstrated the ability of AWP&B processes to produce high performance (Lambe, 2014) suggesting that the requirement for AWP&B processes optimization for further improvement is very important for policy decision making.

The study noted that in the LP model approach to determine optimal solution of fund allocation and performance there was additional slack variables that were introduced into linear constraints of a LP to transform them from inequality constraints to equality constraints. These were difference between the right-hand side and left-hand side of a constraints in the model. The slack variables introduced into the linear constraints of LP were identified as positive for candidate solution, and therefore the particular constraints were non-binding there in the model, as constraints do not restrict the possible changes from that point. However, if slack variables were negative at some point, the point would have been infeasible (not allowed) as it does not satisfy the constraints.

Thus, LP application on the allocated budget for work plan activities indicated that optimization is dynamic in the FFYs of SP for planned recurrent and development activities carried out by the CFCs in the field and thus there is need to re-engineer feasible model for AWP&B processes optimization. Therefore, there is need to provide an integrated approach to optimization of AWP&B processes within the wider management activities to ensure it is part of the KFS long-term objectives and goals to enhance high performance for a consideration of more fund allocation in the negotiation process during the MTB process period.

5.3.4 Formulating AWP&B to ensure effective and efficient and to negotiate for more funds from exchequer and enable attainment of PCs target by CFCs

The empirical result of the study on formulated AWP&B that will be effective and efficient to negotiate for more funds from exchequer and enable attainment of PCs target by CFCs indicated the system can be restructured to conform to the national government requirement to realize complementary responsibility and facilitate the attainment of its vision and mission. The KFS mandate is to provide for the development and sustainable management, including conservation and rational utilization of all forest resources for the socio-economic development of the country and for connected purposes *(*KFS, 2017*)*. Therefore, the study observed that improved AWP&B is key enablers in realization of the performance of the KFS strategic plan objectives and are able to provide services in priority areas in the organization efficiently and effectively to meet society's needs in a way that it conserves and maintains forest ecosystems for present and future generations.

The adopted approach of inclusion output of the parameters in the modeled AWP&B with specifications seemed to be considered as an improved AWP&B structure to enhance work performance of the CFCs. These specification were the actual activities, description of the action/activity in short and precise statement, timeframe indicating which quarter the stated action will be done, tasks indicating what to be performed to complete the planned activity, responsibility indicating the person who leads and should report on the implementations of the activity, means (input) providing each activity inputs required to implement, GOK funding providing GOK allocated budget in implementation, Donor funding, for each activity declaring available/additional funding to implement and finally providing the total budget allocated to the activity (Kshs).

The results of this study further demonstrated that the parameters of the AWP&B were affected by inclusion levels of activities key performance indicators as suggested by a literature by Allen (2013) on a maintenance optimization framework. The model system framework structure therefore provided meaning approach to optimization maintenance decisions (Allen, 2013) and is generic for other system optimization application for an insight and integrated approach. However, based on the findings of similar studies as referred in the literature by Jorgensen (2018) the study supported the content of analysis through his observation that found that models are increasingly used in resource management. The results of this research might suggest that this modeling is a tool that is able to relate quantitatively the impact on an ecosystem with consequences for the same manner only on the objects of interest for the problem that makes the difference.

To sustain management of forests with efficient and effective AWP&B the study observed that it necessitates an integrated approach of inclusion output of result areas/outcome in SP, strategies, expected outputs and KPI entities in the model for AWP&B framework. However there exists ongoing challenges to develop practices that reconcile the management planning and the resource allocation through budgeting. The study established the quad approach of AWP&B system with distinct categories of parameters to forest management (result areas/outcome in SP, strategies, expected outputs and KPI entities) that if properly applied, may be able to address many of the challenges facing contemporary forest management and thereby influence the enabling environment for more fund negotiation.

Feasible model for the AWP&B system with the adoption of an integrated approach of inclusion output of parameters strategies, its application primarily seeks to minimize the total fixed and variable costs to the performance of the organization activities and ensure effective and efficient deployment of existing resources for capability maximization. This study results suggests to answer research question ‘‘How can the AWP&B be made more effective and efficient in order to negotiate for more funds from exchequer and enable attainment of PCs target by CFCs?’’. The study was found to correspond to research on determinants and optimizing delivery of work performance in industrial systems as indicated by MATEC (2017) which showed that the optimization of a system led to a substantial improvement in three work performance indicators that concern deliveries in

industrial systems. The indicators determining potential solutions for effective and efficient improvement on performance according to the study MATEC (2017) included time delivery, backlog efficiency and transport efficiency. Whereas MATEC (2017) focus her work performance outputs on time delivery, backlog efficiency and transport efficiency, the KFS in the other hand focus her work performance on efficient and effective delivery of goods and services.

In the context of AWP&B formulation for negotiation the study found it was necessary to follow the negotiation framework path. For a strong AWP&B to be made more effective and efficient in order to negotiate for more funds from the exchequer and enable attainment of PCs target by CFCs, the study found that it is important to come up with a feasible model of AWP&B. The implementation of the feasible model of AWP&B must be supported by the potential characteristics to resolve the problem arising in the MTB process for resource allocation to programmes. However, the negotiations are vulnerable, unless they are protected by procedural framework strategies that are to be followed by the parties involved (GOK, 2024).

According to GOK, 2024 MTB of the financial year are normally prepared against a background of a contracting global economy occasioned by unforeseen circumstances. As a result, policy frameworks strategy in place for fund negotiation often seems to fall short of providing satisfying solutions to a growing number of problems. These problems are but not limited; individual party are not ready to understand the other party at all, lack

of time to effective negotiation, going unprepared for a negotiation, lack of patience leads to a bad negotiation, criticism, sarcasm, derogatory remarks made by individual party or other parties, last minute changes, being too rigid and lack of confidence. The repercussions of these weaknesses/short comings always led to disagreement in the negotiation during the MTB process. The study found out that printed estimates of FFYs, the annual budgetary allocation has always continued to receive cuts giving the CFCs a tough start in planned activities implementation despite having given a strong bargaining forward AWP&B proposal for consideration in the MTB processes.

Despite challenges experienced using a framework strategy to negotiate fund by parties the study established four opportunities which can be implored to support MTB process negotiation of funds from the exchequer for the planned activities as provided in chapter four. One glaring opportunity from the result is the fourth listed opportunity which states that; framework strategy is a result of historic development working from the past review termed PPRs and it has opportunity to balance different interest of groups with different programmes.

In this strategy, the CFCs is given room to look at the past performance on the implementation of the activities to develop and recommend a strong framework that will support MTB negotiation of funds from exchequer for planned activities. Formulated structure system for efficient and effective AWP&B will realize a substantial improvement in work performance in management of the resource for attainment of

expected results. The formulated structure for efficient and effective AWP&B processes was found to be the epitome by the study to enhance work performance of the KFS as an organization. The structure is integrated into the optimized innovations of the system development context that facilitates improvement of work performance. Indeed, status quo of doing business in management has often been the activator of ‘‘creative of poor performance’’ in a corporate organization. Realization of optimized system in the study illustrated that innovations is good as a paradigm shift on the way of doing business to enhance work performance. Therefore, the developed system can act as a catalyst that destructs old system structures while simultaneously providing new opportunities that help to create new, more viable structures.

Analysis of the AWP&B showed that there is an enhancement in work performance and this in turn, is resulting into improvement work performance expectation. Thus, there is need to put in place appropriate and improved AWP&B structure to be implemented in the work place and incorporate a clear set of strategic vision for operational purposes. As a step forward, it also calls for redesigning of proper guidelines on development of AWP&B document for the forest sector and other institutions to follow to enhance their respective work planning and budget for work performance improvement. However, the analysis of framework for negotiation strategy the results showed a vulnerable practice, unless they are protected by procedural framework strategies that are to be followed by the parties involved.

The study found that negotiation for adequate fund in the MTB processes was affected by a contracting global economy occasioned by unforeseen circumstances. As a result, policy frameworks strategy in place for fund negotiation often seems to fall short of providing satisfying solutions to a growing number of problems presented by programmes. The study noted that every FFYs it's always a tough balancing act for treasury as he tries to raise the hope of a nation seeking relief from the economic shock of the devastating problems in the country amid grappling revenue shortfall. In the midst of this dilemma, the study found that most pressing priorities by the Government is to find money from a thin resource envelope in the 'basket of fund' for the country's ''Agenda'' legacy projects, borrowing to plug the budget deficits and delivering on the promise made to the IMF. The challenge the treasury faces is to strike a balance between increasing taxes to boost revenues while ensuring that the citizens are not impoverished further.

In real situation a high tax burdens the citizen and it reduces productivity and, in a context, where jobs have been lost and businesses are struggling its center-productive. Therefore, given the circumstance, the National Treasury should focus on cost-management, put on hold non-priority items and spare the citizens from the agony of high taxes. Despite challenges experienced using a framework strategy to negotiate fund by parties there are opportunities which can be implored to support MTB processes negotiation of funds from exchequer. The remedy for building up the resource envelope to resolve the issue of fund allocation deficit, the study noted that it is to control expenditure by the programmes. In the process the adding of more taxes to consumers to

raise more fund will be avoided. Other opportunities established by the study included; the framework strategy in negotiation describes the way the programmes offer their proposal that strongly affects how the others view them, the framework strategy stresses what the other party would gain rather than lose is an important form of framing in negotiation, the framework strategy enables the negotiator think positive, prepare, think about the best and worst outcome before negotiation, articulate issues and build value, give and take and framework strategy is a result of historic development working from the past review termed PPR and it has opportunity to balance different interest of groups with different programmes.

In conclusion, from the forest resource economics research on the delivery of AWP&B processes, the initiative can inform a wide range of forest policy applications that may include first, sustainable forest management policies. In the application, we can use research to develop policies that balance timber production which is the outcome of the purpose of the activity of forest plantation establishment in the study. In this policy, we can implement harvest limits or selective logging based on economic models that factors in ecosystem service value.

Secondly, forest policy application can consider area of forest-based livelihoods and poverty alleviation. The application can be designed to fit policies that enhance income from forests from the production of bamboo another area of the study for the benefits of rural communities. The community forest programs can be supported by economic

evaluations of Non-Timber Forest Products (NTFP) and work closely with the CFCs so that they can benefit from accrued resources from the forest.

Thirdly, forest policy application can consider an area of climate change and carbon sequestration. The application can be designed to fit policies that support natural forest conservation to promote the forests as carbon sinks. Economic analysis can support afforestation vs avoided deforestation in climate mitigation strategies.

Fourthly, forest policy application can consider an area of forest taxation and incentives. The application can be designed to fit policies that guide tax policy or subsidies that encourage conservation and/or reforestation by differential land taxation and tax breaks for afforestation investments.

Lastly, forest policy application can consider area of forest tenure and property rights. The application can be designed to fit policies that inform land tenure reforms to promote efficient and equitable use of forest resources by showing how secure land rights increase investment in sustainable forest management practices.

Ignoring the consideration of these wide range of forest policy application may lead to poor management of forests facilitated by inadequacy of financial resource that is required to be used to implement the planned activities.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This chapter provides reasoned judgements about the study's findings for conclusion. It has summarized the key findings and provided an interpretation of the results by drawing inferences from the data. The chapter has considered all variables and relating cause and effect. The analysis, evaluation and comparisons in the findings has provided a clear understanding of the study's outcomes to enable the researcher draw conclusions.

Further, the specific actions based on the conclusion have been identified for recommendations thereby providing sufficient knowledge and information for the policy and management. The recommendations have also proposed how to utilize the findings and provided additional areas for further research with an aim to find the best course of action in the study.

6.2 Conclusions

The study on the impact of AWP&B processes on performance of CFCs generally shows that a well-structured work plan and properly allocated budget significantly enhance organizational performance providing a higher satisfaction performance indicator. Key findings in the study include amongst others; clarity and direction of work performance. In this area a detailed work plan provides clear objective, timeliness, and responsibilities,

which improve coordination and accountability among the team members due to carry out the activities. On resource optimization, the study noted that an effective budget ensures that resources are allocated efficiently, preventing waste and enabling timely execution of activities. The study noted that the implementation AWP&B processes require performance monitoring. In this phenomenon AWP&B processes serves as benchmarks for monitoring progress and performance, making it easier to identify issues early and adjust accordingly. On the issues of increased efficiency, when the study aligns the work with a structured plan and realistic budget, operational efficiency and goal attainment improve. Other area of policy implication is the involvement of stakeholder confidence. The study noted that transparent planning and budgeting builds trust with stakeholders, enhancing support and funding opportunities.

6.2.1 Conformity of the amalgamated AWP&B of KFS to requirement by the treasury guidelines as stipulated in MTB process for funds allocation from exchequer.

The descriptive analysis investigating the conformity of the amalgamated AWP&B of KFS showed that the organization did not conform fully with the requirement by the treasury guidelines as stipulated in MTB process for funds allocation from the exchequer. There were non-conformities of AWP&B processes by the organization experienced. These were areas of consideration in MTB process not observed by organization. Amongst consideration not observed included; underpinning the MTB processes fiscal structure which the organization had under performance of delivery of goods and services

to qualify for more fund, priorities of the activities implemented in the FFYs, the outputs and outcomes were not delivered within a tight fiscal environment (taxation, revenue, expenditure and debt), form and content of budget negotiated for allocation not fully presented by vote and workplan in accordance with section 38 (3) (b) of Public Finance Management Act, 2012, vote and programme budget ceiling of the activities to be funded there was gaps in the approved budget resulting to constraints in the implementation of the AWP&B and finally PPRs of AWP&B activities implemented had underperformance of non-financial indicators.

The AWP&B processes of the institution showed that institutional perceived ‘‘rational’’ decision about the system acquiring new potential solutions and its associated procedures and structures were invested with socially shared meanings rather than simply being responses to system demands as required by the treasury guidelines and procedures.

The rationale of level approach in delivery of policy making process mechanism for fund allocation showed that organizations involves in MTB processes examine the various stages of policy formulation of budget and policy analysis as well as the instruments that governments have put in place in their guidelines to achieve the optimal fund allocation. Where participants are exposed to fundamental struggle in the budget negotiation, the organizations who vie for the same ‘basket of fund’ need to make a strong presentation to ensure enough funds are given to them. Consequently, if these considerations required by the government are observed well the organization will get enough funds from exchequer

and be able implement their AWP&B effectively and be able answer the study research question that require conformity of treasury guideline in MTB process for funds allocation from exchequer.

6.2.2 The performance of CFCs against their PCs targets as indicated in their AWP&B

The inferential statistics analysis investigating evaluation on performance of CFCs against their PCs targets as indicated in their AWP&B indicated a significant impact showing the performance of CFCs PCs targets were not fully achieved as expected. Results showed that the performance of CFCs did not support full realization of their PCs targets as indicated in their AWP&B. Chi-square ($\chi 2$) test statistics results showed that the calculated value (79.81) was greater than the critical value (5.99) at 95% ($\alpha = 0.05$) implying significant differences between CFCs performance and expectations. The reason for under achievement established was that the CFCs do not receive adequate funds over the years to enable them run their activities efficiently and effectively. The inadequate funds reflected sizeable financial woes in the county to realize their expected results of planned activities implementation.

6.2.3 Correlation between funds allocation and performance of CFCs

The descriptive analysis investigating derived correlation between funds allocation and performance of CFCs with application of LP model of optimization established constraints of budget, raw materials cost, labour cost and machine operation cost due to

limited fund allocation. These constraints had a negative effect on performance of the CFCs in terms of the level of major activities done.

The results of the analysis indicated a significant negative correlation between performance and budget gap and a significant positive correlation between performance and budgetary allocation. Thus, there is need to enforce the legislative system with regard to resource allocation to enable CFCs achieve their PCs targets as planned in the FFYs. The CFCs can realize greater level of performance from the allocated funds by focusing greater efforts on tree seedling production, plantation establishment and bamboo seedling production as these presents a marked sensitivity to budgetary allocation.

Engaging and securing increased funding from the government, there is need to enforce the legislative system with regard to resource allocation to enable CFCs achieve their PCs targets as planned in the FFYs. In attempt to minimize the total fixed and variable costs to the level of performance of the organization activities to ensure effective and efficient deployment of existing resources for capability maximization, the LP model application for optimization investigating the relationship between performance and budget gap and budget allocation revealed that some activities including tree seedling production, plantation establishment and Bamboo seedling production had strong ties between the three variables. Therefore, it is pertinent that the use of budget as a planning and control tool for management should be relooked in order to improve the AWP&B structure and be accepted without any hindrances in the MTB process.

6.2.4 Formulating AWP&B to ensure effective and efficient to negotiate for more funds from exchequer and enable attainment of PCs target by CFCs.

The descriptive analysis of reviewing and formulating AWP&B that will be effective and efficient to negotiate for more funds from the exchequer and enable attainment of PCs target by CFCs established ten characteristics of key enablers that can be considered and used to improve AWP&B processes. These enablers include; availability of fund for immediate use, attainable planned activity targets for the set goals and objectives, good state of activities with a guiding process for implementation, favorable environment conditions for attainment of optimal results, needs and objectives of the sector in place, availability of required resources for organization to run effectively, accessibility of locality of site to carry out the activity, sound socio-economic status benefits of the enterprise to local community, focused social responsibility of the implementer and availability of personnel for efficient productivity. These characteristics enabled the structure formulation to answer the research question that tend to look at how AWP&B can be made more effective and efficient in order to negotiate for more funds from exchequer and enable attainment of PCs target by CFCs.

6.3 Recommendations

6.3.1 Policy and management recommendation

The findings of this study provide sufficient knowledge and information for the following Policy and management recommendation;

1) To put in place effective and efficient AWP&B (by continuously looking at outputs vs inputs) that will fully conform to requirement by the treasury guidelines for funds allocation and actively engage exchequer for increased funding level base for delivery of AWP&B.
2) To implement a co-financing/cost sharing model in delivering AWP&B by exploring, securing and harnessing diversified funding sources, including private stakeholders, public-private partnership and international grants to enable the CFCs get adequate fund to implement the field activities and improve their performance.
3) To allocate limited resources (e.g. labour, capital, time) to maximize profit or minimize cost, based on the LP solution in optimal resource allocation.
4) To identify bottlenecks or overly tight constraints and consider relaxing these constraints if doing so improves outcomes in constraints management using LP on optimization.
5) To implement decision rules or policies suggested by the LP model to ensure optimal outcomes under given constraints in policy formulation.
6) To improve the AWP&B that will be effective and efficient to negotiate for more funds from the exchequer and enhances better financial planning to ensure timely release and optimal utilization of allocated funds that will enable attainment of PCs target by CFCs.

6.3.2 Further research recommendation

This study confined itself to AWP&B as a considerable area for negotiation of fund from exchequer. Further research should be undertaken to study other areas appropriate for consideration that may include the strategic plan for the organization.

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APPENDICES

APPENDIX I: A LETTER OF TRANSMITTAL

Dear Respondent,

I hereby wish to request you to express your views on the attached administered questionnaire on Annual Work Plan and Budget (AWP&B). The views expressed in the completed questionnaire will be treated in strictest confidence. Information identifying the respondents will not be disclosed.

Your opinion and success of this survey will depend on your participation and honest responses. I would therefore greatly appreciate your response in answering the questionnaire. Please be assured that your responses will be kept strictly confidential. The strict ethic guidelines of University of Eldoret, Kenya will ensure anonymity is maintained at all time. Thus, no names are required. Individual participants will not be identified in the analysis as only aggregated results will be analyzed and presented.

The present survey is part of my research study for PhD Degree in Forest Economics and Management. The tool of questionnaire is designed in such a way that one questionnaire to be answered by more than one person determined by his/her area of work. However, the CFCs will be the determinant respondent in the survey exercise as the top management personnel in the county. Please note that there are no correct or incorrect responses. I am merely interested in your personal point of view and understanding guided by the existing records of information of the progress reports and returns of the financial year of performance contract and the AWP&B.

Thank you very much. It is only with your generous help that this Doctoral study of academic excellence can be successful.

Sincerely,

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P.O. Box 1125-30100, Eldoret, Kenya.

APPENDIX II: QUESTIONNAIRE

1. BASIC INFORMATION

Conservancy……County…….

Dates of Research Visit: Start ……...… End: …….…….

Area of State Forests in Ha: …… No of Forest Stations ……

No of Sub County…….……...

No. of Technical Officers: …… No. of Rangers: ……...……

No. of Unskilled Staff: ……

No. Other Staff (Specify skills): .....

Total No. of Motor Vehicles: …….….

No. of Serviceable M/Vehicles: ……...…...

No of plants, machineries and equipment…….…….

Total No. of Motorcycles: …….…….

No. of Serviceable Motorcycles: ……...…….

No of office equipment…….…….

1.1. Do you have Annual Work plan for the current year? 1- Yes 2- No *(Tick appropriate response)*

1.2. If no, how have you been operating? Briefly explain

……

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1.3. Do you have Forest Management Plan for your County? 1- Yes 2- No

(Tick (√) appropriate response)

1.4. If no, how have you been operating? Briefly explain

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……

1.5. Provide a list of Partners/Stakeholders supporting forest activities in the County…….....……

……..……

……...……...……

2. SEEDLINGS PRODUCTION

2.1. How many tree nurseries do you have in the County? ……...……...

2.2. What is the overall target for seedlings production for the County in the current FY? …….

2.3. What is the KFS target for seedling production in the County? (*Use the table here below*)

Programme	**No. of Exotic**	**No. of Indigenous**	**Total**	**Remarks**
Plantation				
Natural forest conservation				
Farm & dryland forestry				

Seek for a breakdown and complete the table here below:

Name of Nursery	**No of Nurseries**	**No. of Seedlings Brought Forward from previous FY**	**No of Seedlings Pricked out During Current FY**	**Seedlings Received from Other Nurseries**	**Total Seedlings**
KFS					
CFAs					
Saw millers					
County Government					
Primary Schools					
Secondary Schools					
Projects (Specify)					
NGOs (specify)					
Individuals					
Others- Specify					
Total					

2.4. Did you receive any allocation of funds for producing tree seedlings? 1- Yes 2- No *(Tick (√) appropriate response)* Specify the amount and source…….……

2.5. What is your total expenditure? Kshs……...…….

2.6. How many man-days have you utilized to-date? .....

2.7. What other inputs have you used? Specify the input and the source.....……

2.8. State any challenges encountered in producing these seedlings:

……

……

……

……

2.9. Do you have any innovative measure tried and either worked well or did not work well in your jurisdiction? 1- Yes 2. No

2.10. Briefly explain

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3. TREE PLANTING:

PLANTATION ESTABLISHMENT

3.1. What is the plantation establishment target for the current financial Year? ……. (Ha)

3.2. What is the progress of this year planting preparation? (Site clearing, cutting stake, staking out, pitting, planting): (*use the table here below*)

Activity	Target	Achievement	Remarks
Site clearing (Ha)			
Cutting stake (Ha)			
Staking out (Ha)			
Planting (Ha)			
Others (Specify)			

3.3. If none, explain the reasons

……

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……..…..

3.4. If yes, how much was the cost of preparation? Kshs …….

3.5. How many hectares did you establish last financial year? ……...…….…….. (Ha)

3.6. What was the target for the plantation establishment? ..... (Ha)

3.7. Have these established areas been surveyed, mapped and other details entered in the Compartment register?

Yes……..... No……..……...….

3.8. If yes, seek to check the Compartment Register and analyze the entries and in particular the survival rate. If low survival rate is recorded seek to get reasons for this;

……

……

If relevant details of the established forest plantation areas have not been entered into the compartment register, seek to get the reasons for this:

……

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3.9. What forest plantation area in hectares was established entirely by KFS resources (Seedlings and casuals)? ……..……..……. (Ha)

3.10. What forest area was established entirely by other partners /stakeholders' resources (Seedlings and casuals)? ……..……..…. (Ha)

NATURAL FORESTS REHABILITATION

3.11. Have you identified and mapped degraded forest areas under your jurisdiction for rehabilitation? Yes / No

3.12. If yes, specify the area ……..…. (Ha)

3.13. How much forest area have you planned to rehabilitate this financial year?.....(Ha)

3.14. How much area under rehabilitation through protection for natural regeneration is planned? …….……. (Ha)

3.15. How much area under rehabilitation through enrichment planting is planned? ……. (Ha)

3.16. How much was achieved under rehabilitation in the last FY?

Natural regeneration ……..…. (Ha)

Enrichment planting …….……. (Ha)

3.17. Do you have an area under invasive species in your county? Yes / No

3.18. If yes specify the location, Hectarage and species.

.....……..……

……

……

3.19. What intervention measures do you have in place to manage invasive species?

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3.20. What is your target this year for the eradicating the invasive species?

…….……..…(Ha)

3.21. What was your achievement (control of invasive species) for the last financial year? **……..…….. (**Ha)

FARM AND DRYLAND FORESTRY DEVELOPMENT

3.22. What is the area under Farm & Dryland forestry in your county?

.....(Ha)

3.23. How many nurseries do you have for Farm and Dryland forestry development?

……..……

3.24. How many seedlings available for Farm and Dryland forestry development in your county? .....

3.25. Specify the ownership of nurseries, quantities, species and ownership.

Category of Nursery (e.g., private, CBO, companies, KFS etc.)	**Quantity**	**Exotic**	**Indigenous**	**Total**
1				
2				
3				
4				
5				

3.26. Do you have any private forest registered in your county? (Provide details on the registration)

……..……

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……

3.27. Do you have plans for registration of more private forests on this financial year?

…….

What is the achievement? .....

3.28. What is your target for establishing commercial farm forests this year? ..... (Ha)

3.29. What is the achievement so far…. ……..…….……. (Ha)

3.30. List the three most preferred species for commercial farm forestry in your county

1)……

2) ……

3) ……..…..

3.31. What are the three most common uses for the species you have listed above?

……

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4. BAMBOO ESTABLISHMENT

4.1 Do you have a nursery for bamboo seedlings? If yes, what is the source of propagation materials? ……..

4.2 How Many seedlings of bamboo do you have? ……...…

4.3 What is your target for establishing commercial Bamboo forests this financial year? ..... (Km)

4.4 What is the achievement so far? ……..…… (Ha)

4.5 List the three most preferred species of bamboo for commercial purposes in your county

1) ……

2) ……...…….

3) ……..…….

4.6 What are the three most common uses for the species you have listed above?

1).....

2).....

3) .....

5. PARTNERSHIPS WITH PRIVATE LAND OWNERS

5.1 What is the target for the developing partnerships with private land owners to establish plantations and other forest enterprises this financial year? .....

5.2 How many partnerships have so far been developed with private land owners on plantation establishment and other forest enterprises? .....

5.3 What is the total forest area under these partnerships? .....(Ha)

5.4 Who are these partners? .....

5.5 What are the preferred species? .....

5.6 List other forest enterprises other than plantation establishment under these partnerships .....

5.7 What is the approximate number of beneficiaries from these forest enterprises? (Households) .....

5.8 Who are the other partners supporting forests development in the county?

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5.9 What specific support is each of these partners providing to your county?

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5.10 What are the achievements? (*Use the table here below*)

Name of Partner	**Area of Support**	**Achievements**	**Remarks**

6. TRANSITION IMPLEMENTATION PLANS

6.1 What type of support does the county government need from KFS to implement TIPs?

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6.2 What support are you giving to the county government to implement TIPs?

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6.3 What challenges are you experiencing in providing the support mentioned above?

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7. REHABILITATION AND MAINTENANCE OF FOREST ROADS

7.1 How many kilometers of forest roads do you have in your county? ……..……

7.2 How many kilometers of these roads are graded? .....

7.3 How many kilometers have you targeted for gravelling, light grading and heavy grading?

Use the table below to answer the question.

Type of activity	**Target for the FY**	**Achievement**	**Remarks**
Gravelling (Km)			
Light grading (Km)			
Heavy grading (Km)			
Bridges (No.)			

7.4 What are the challenges faced during construction and rehabilitation of forest roads in your county?

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7.5 What were the lessons learnt?

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……..……..

8. ECOTOURISM, WAYLEAVES AND INSTALLATIONS

8.1 **P**rovide details of the ecotourism facilities, way leaves, communication masts installed in your county. (*Use the table here below*)

Type of activity	**Number of existing facilities**	**Target for current financial year**	**Achievement**	**Remarks**
Ecotourism				
Wayleaves				
Installation				
Others (specify)				

9. SILVICULTURAL TREATMENT ACTIVITIES

9.1 Provide details of achievements of specific silvicultural treatments you have carried out during this financial year.

Silvicultural Activity	**Achieved last financial Year**	**Target for this financial year**	**Achievement this current year**	**Remarks (Include species)**
Pruning				
1st Pruning (Ha)				
2nd Pruning (Ha)				
3rd pruning (Ha)				
Others (specify)				

Silvicultural Activity	Achieved last financial Year	Target for this financial year	Achievement this current year	Remarks (Include species)
Thinning (Ha)				
1st Thinning (Ha)				
2nd Thinning (Ha)				
3rd Thinning (Ha)				
Others(specify)				
Coppice Reduction (Ha)				
Creeper Cutting (Ha)				
Respacing (Ha)				

9.2 What challenges have you encountered in the course of carry out these treatments?

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9.3 What lessons have you learnt?

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10. CONSTRUCTION/REFURBISHMENT OF RANGER HOUSES

10.1 How many ranger houses do you have in your county? …….

10.2 How many of the ranger houses are habitable? ……

10.3 What is the target number for ranger houses to be constructed? …….

10.4 How many new ranger houses are under construction? …….

10.5 What is the status of completion? ……..

10.6 How much was allocated for construction of the ranger houses? ……

10.7 How much has been spent on the construction? ……..……

10.8 What is target number for refurbishment of ranger houses this financial year? .....

10.9 What is the status of completion? …….……

10.10 How much was allocated for refurbishment of the ranger houses? ……..……

10.11 How much has been spent on the refurbishment? ……

11. REVENUE COLLECTION

11.1 What is the target of revenue collection for the current financial year? .....

11.2 What was the total revenue collected last financial year? .....

11.3 What is the achievement of revenue collection?

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11.4 What are the sources of revenue in the county?

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(*Use the table here below*)

Source of revenue	**Achievement of revenue collected last FY (Kshs)**	**Target of revenue collection for this FY (Kshs)**	**Achievement of revenue collection**	**Remarks**
Timber				
Fuel wood				
Grazing				
Movement permits				
Poles				
Ecotourism				
Installations				
Wayleaves				
Water Abstractions & Easements				
Others (Specify)				

11.5 What are the modes of revenue collection? .....

11.6 Have you fully adopted the cashless mode of revenue collection? (Yes/No) …….

11.7 If yes, what are the benefits?

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11.8 What are the challenges? (If any)

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11.9 What are the lessons learnt? (*Please provide briefly a general remark on corporate planning and budget as a process by which an organization estimates its finances for a future period and plans its operations accordingly)*

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Thank you for your response

APPENDIX III: CRITICAL VALUES OF CHI-SQUARE (χ^2) DISTRIBUTION TABLE

Degree of Freedom	Significance level			Degree of Freedom	Significance level		
	0.10	**0.05**	**0.1**		**0.10**	**0.05**	**0.1**
1	2.71	3.84	6.63	16	23.54	26.3	32.00
2	4.61	**5.99**	9.21	17	24.77	27.59	33.41
3	6.25	7.81	11.34	18	25.99	28.87	34.81
4	7.78	9.49	13.28	19	27.20	30.14	36.19
5	9.24	11.07	15.09	20	28.41	31.41	37.57
6	10.64	12.59	16.81	21	29.62	32.67	38.93
7	12.02	14.07	18.48	22	30.81	33.92	40.29
8	13.36	15.51	20.09	23	32.01	35.17	41.64
9	14.68	16.92	21.67	24	33.20	36.42	42.98
10	15.99	18.31	23.21	25	34.38	37.65	44.31
11	17.28	19.68	24.72	26	35.56	38.89	45.64
12	18.55	21.03	26.22	27	36.74	40.11	46.96
13	19.81	22.36	27.69	28	37.92	41.34	48.28
14	21.06	23.68	29.14	29	39.09	42.56	49.59
15	22.31	25.00	30.58	30	40.26	43.77	50.89

APPENDIX IV: COUNTY FOREST CONSERVANCIES (Constitution of Kenya, First Schedule Article 6(1), 2010)

Counties			
1. Mombasa	2. Kwale	3. Kilifi	4. Tana River
5. Lamu	6. Taita/Taveta	7. Garissa	8. Wajir
9. Mandera	10. Marsabit	11. Isiolo	12. Meru
13. Tharaka-Nithi	14. Embu	15. Kitui	16. Machakos
17. Makueni	18. Nyandarua	19. Nyeri	20. Kirinyaga
21. Murang'a	22. Kiambu	23. Turkana	24. West Pokot
25. Samburu	26. Trans Nzoia	27. Uasin Gishu	28. Elgeyo/Marakwet
29. Nandi	30. Baringo	31. Laikipia	32. Nakuru
33. Narok	34. Kajiado	35. Kericho	36. Bomet
37. Kakamega	38. Vihiga	39. Bungoma	40. Busia
41. Siaya	42. Kisumu	43. Homa Bay	44. Migori
45. Kisii	46. Nyamira	47. Nairobi City	

(Source: Constitution of Kenya, 2010)

APPENDIX V: VOTE AND PROGRAMME BUDGET CEILING OF THE ACTIVITIES TO BE FUNDED BY ENVIRONMENT PROTECTION, WATER AND NATURAL RESOURCES

(a) Recurrent Sector Ceiling for the FY 2021/22-2023/24 (Kshs Million)

Details of Sector and Votes	Economic Classification	Printed Estimate by 2020/21	Ceiling		
			2021/22	2022/23	2023/24
Environment Protection, Water and Natural Resources	Gross	27,233.0	26,656.0	27,875.0	26,047.0
	A.I.A	7,953.1	8,371.0	8,371.0	8,371.0
	Net	19,300.7	10,205.0	19,500.0	17,676.0
	Salaries	2,672.0	2,660.0	2,740.0	2,823.0
	Grants & Transfers	21,134.0	23,591.0	23,594.0	21,594.0
	Other Recurrent	823.5	1,402.0	1,537.0	1,630.0
	Strategic interventions	603.0	-	-	-
	Economic stimulus programme	2,000.0	-	-	-

(Source: Guidelines for finalizing the estimates for the FY 2021/22 and the MTB: The National Treasury and Planning Circular No.3/ 2021)

(b) Development Sector Ceiling for the FY 2021/22-2023/24 (Kshs Million)

Details of Sector and Votes	Economic Classification	Original Approved Estimates	Ceiling		
		2020/21	2021/22	2022/23	2023/24
Environment Protection, Water and Natural Resources	Gross	70,982.8	69,747.0	84,558.0	98,062.0
	GOK	16,121.0	20,810.0	26,818.0	32,644.0
	Loans	41,448.8	45,968.0	54,771.0	62,449.0
	Grants	2,969.0	2,969.0	2,969.0	2,969.0
	Local A.I.A	-	-	-	-
	Big four Agenda	2,482.0	-	-	-
	Economic stimulus programme	7,963.0	-	-	-
	Counter funding	2,000.0	-	-	-
	Strategic intervention	-	-	-	-

(Source: Guidelines for finalizing the estimates for the FY 2021/22 and the MTB: The National Treasury and Planning Circular No.3/ 2021)

APPENDIX VI: OPTIMIZATION MODELING TABLE FOR CORRELATION BETWEEN FUND ALLOCATION AND IMPLEMENTATION OF TARGETED ACTIVITY

County 1: Kakamega				
Activity	**Unit**	**Target**	**Unit Cost (Kshs)**	**Amount requested (Kshs)**
Tree seedlings production	No	1,000,000.00	5.50	5,500,000.00
Plantation Establishment	Ha	300.00	22,194.00	6,658,200.00
Natural Forests Rehabilitation	Ha	85.00	22,194.00	1,886,490.00
Commercial farm forests establishment	Ha	750.00	14,400.00	10,800,000.00
Bamboo seedling production	No	1,000.00	9.00	9,000.00
Rehabilitation and Maintenance of Forest Roads	Km	48.00	50,000.00	2,400,000.00
Silvicultural Treatment (Pruning)	Ha	613.00	8,220.00	5,038,860.00
Total Amount requested for the activities	Kshs			32,292,550.00
Total amount allocated for the activities	Kshs			29,000,000.00
Constraints	**Unit**	**Target**	**Unit Cost (Kshs)**	**Cost (Kshs)**
Raw material (Polythene tube for tree seedling production)	No	1,000,000	0.8	800,000.00
Raw material (Polythene tube for Bamboo seedling production)	No	1,000	1.6	1,600.00
Labour (Plantation establishment)	Ha	300	22,194	6,658,200.00
Labour (Natural Forest establishment)	Ha	85	22,194	1,886,490.00
Labour (Commercial farm forests establishment)	Ha	750	14,400	10,800,000.00
Labour (Silvicultural Treatment)	Ha	613	8,220	5,038,860.00

Machine operation	Km	48	50,000	2,400,000.00

County 2: Garissa				
Activity	**Unit**	**Target**	**Unit Cost (Kshs)**	**Amount requested (Kshs)**
Tree seedlings production	No	500,000.00	5.50	2,750,000.00
Natural Forests Rehabilitation	Ha	10.00	22,194.00	221,940.00
Commercial farm forests establishment	Ha	629.00	14,400.00	9,057,600.00
Total Amount requested for the activities	Kshs			12,029,540.00
Total amount allocated for the activities	Kshs			11,000,000.00
Constraints	**Unit**	**Target**	**Unit Cost (Kshs)**	**Cost (Kshs)**
Raw material (Polythene tube for tree seedling production)	No	500,000	0.8	400,000.00
Labour (Natural Forest establishment)	Ha	10	22,194	221,940.00
Labour (Commercial farm forests establishment)	Ha	629	14,400	9,057,600.00

County 3: Marsabit				
Activity	**Unit**	**Target**	**Unit Cost (Kshs)**	**Amount requested (Kshs)**
Tree seedlings production	No	300,000.00	5.50	1,650,000.00
Natural Forests Rehabilitation	Ha	500.00	22,194.00	11,097,000.00
Commercial farm forests establishment	Ha	250.00	14,400.00	3,600,000.00
Total Amount requested for the activities	Kshs			16,347,000.00
Total amount allocated for the activities	Kshs			14,000,000.00
Constraints	**Unit**	**Target**	**Unit Cost (Kshs)**	**Cost (Kshs)**
Raw material (Polythene tube for	No	300,000	0.8	

tree seedling production)				240,000.00
Labour (Natural Forest establishment)	Ha	85	22,194	1,886,490.00
Labour (Commercial farm forests establishment)	Ha	750	14,400	10,800,000.00

County 4: Nakuru				
Activity	**Unit**	**Target**	**Unit Cost (Kshs)**	**Amount requested (Kshs)**
Tree seedlings production	No	1,070,000.00	5.50	5,885,000.00
Plantation Establishment	Ha	527.00	22,194.00	11,696,238.00
Bamboo seedling production	No	2,500.00	9.00	22,500.00
Rehabilitation and Maintenance of Forest Roads	Km	48.00	50,000.00	2,400,000.00
Silvicultural Treatment (Pruning)	Ha	613.00	8,220.00	5,038,860.00
Total Amount requested for the activities	Kshs			17,603,738.00
Total amount allocated for the activities	Kshs			11,000,000.00
Constraints	**Unit**	**Target**	**Unit Cost (Kshs)**	**Cost (Kshs)**
Raw material (Polythene tube for tree seedling production)	No	1,070,000	0.8	856,000.00
Raw material (Polythene tube for Bamboo seedling production)	No	2,500	1.6	4,000.00
Labour (Plantation establishment)	Ha	527	22,194	11,696,238.00
Labour (Silvicultural Treatment)	Ha	613	8,220	5,038,860.00
Machine operation	Km	48	50,000	2,400,000.00

County 5: Baringo				
Activity	**Unit**	**Target**	**Unit Cost (Kshs)**	**Amount requested (Kshs)**
Tree seedlings production	No			

		1,500,000.00	5.50	8,250,000.00
Plantation Establishment	Ha	200.00	22,194.00	4,438,800.00
Rehabilitation and Maintenance of Forest Roads	Km	57.00	50,000.00	2,850,000.00
Silvicultural Treatment (Pruning)	Ha	100.00	8,220.00	822,000.00
Total Amount requested for the activities	Kshs			16,360,800.00
Total amount allocated for the activities	Kshs			11,000,000.00
Constraints	**Unit**	**Target**	**Unit Cost (Kshs)**	**Cost (Kshs)**
Raw material (Polythene tube for tree seedling production)	No	1,500,000	0.8	1,200,000.00
Labour (Plantation establishment)	Ha	200	22,194	4,438,800.00
Labour (Silvicultural Treatment)	Ha	100	8,220	822,000.00
Machine operation	Km	57	50,000	2,850,000.00

County 6: Nyeri				
Activity	**Unit**	**Target**	**Unit Cost (Kshs)**	**Amount requested (Kshs)**
Tree seedlings production	No	1,500,000.00	5.50	8,250,000.00
Plantation Establishment	Ha	240.00	22,194.00	5,326,560.00
Rehabilitation and Maintenance of Forest Roads	Km	74.00	50,000.00	3,700,000.00
Silvicultural Treatment (Pruning)	Ha	200.00	8,220.00	1,644,000.00
Total Amount requested for the activities	Kshs			18,920,560.00
Total amount allocated for the activities	Kshs			14,000,000.00
Constraints	**Unit**	**Target**	**Unit Cost (Kshs)**	**Cost (Kshs)**
Raw material (Polythene tube for tree seedling production)	No	1,500,000	0.8	1,200,000.00

Labour (Plantation establishment)	Ha	240	22,194	5,326,560.00
Labour (Silvicultural Treatment)	Ha	200	8,220	1,644,000.00
Machine operation	Km	74	50,000	3,700,000.00

County 7: Taita Taveta				
Activity	**Unit**	**Target**	**Unit Cost (Kshs)**	**Amount requested (Kshs)**
Tree seedlings production	No	313,000.00	5.50	1,721,500.00
Bamboo seedling production	No	550.00	9.00	4,950.00
Total Amount requested for the activities	Kshs			1,726,450.00
Total amount allocated for the activities	Kshs			700,000.00
Constraints	**Unit**	**Target**	**Unit Cost (Kshs)**	**Cost (Kshs)**
Raw material (Polythene tube for tree seedling production)	No	313,000	0.8	250,400.00
Raw material (Polythene tube for Bamboo seedling production)	No	550	1.6	880.00

County 8: Kwale				
Activity	**Unit**	**Target**	**Unit Cost (Kshs)**	**Amount requested (Kshs)**
Tree seedlings production	No	1,500,000.00	5.50	8,250,000.00
Plantation Establishment	Ha	50.00	22,194.00	1,109,700.00
Natural Forests Rehabilitation	Ha	200.00	22,194.00	4,438,800.00
Bamboo seedling production	No	2,000.00	9.00	18,000.00
Rehabilitation and Maintenance of Forest Roads	Km	40.00	50,000.00	2,000,000.00
Total Amount requested for the activities	Kshs			15,816,500.00

Total amount allocated for the activities	Kshs			14,000,000.00
Constraints	**Unit**	**Target**	**Unit Cost (Kshs)**	**Cost (Kshs)**
Raw material (Polythene tube for tree seedling production)	No	1,500,000	0.8	1,200,000.00
Raw material (Polythene tube for Bamboo seedling production)	No	2,000	1.6	3,200.00
Labour (Plantation establishment)	Ha	50	22,194	1,109,700.00
Labour (Natural Forest establishment)	Ha	200	22,194	4,438,800.00
Machine operation	Km	40	50,000	2,000,000.00

County 9: Embu				
Activity	**Unit**	**Target**	**Unit Cost (Kshs)**	**Amount requested (Kshs)**
Tree seedlings production	No	2,000,000.00	5.50	11,000,000.00
Plantation Establishment	Ha	80.00	22,194.00	1,775,520.00
Commercial farm forests establishment	Ha	500.00	14,400.00	7,200,000.00
Bamboo seedling production	No	1,600.00	9.00	14,400.00
Rehabilitation and Maintenance of Forest Roads	Km	55.00	50,000.00	2,750,000.00
Silvicultural Treatment (Pruning)	Ha	90.00	8,220.00	739,800.00
Total Amount requested for the activities				22,739,920.00
Total amount allocated for the activities				21,000,000.00
Constraints	**Unit**	**Target**	**Unit Cost (Kshs)**	**Cost (Kshs)**
Raw material (Polythene tube for tree seedling production)	No	2,000,000	0.8	1,600,000.00
Raw material (Polythene tube for Bamboo seedling production)	No	1,600	1.6	2,560.00

Labour (Plantation establishment)	Ha	80	22,194	1,775,520.00
Labour (Commercial farm forests establishment)	Ha	500	14,400	7,200,000.00
Labour (Silvicultural Treatment)	Ha	90	8,220	739,800.00
Machine operation	Km	55	50,000	2,750,000.00

County 10: Kirinyaga				
Activity	**Unit**	**Target**	**Unit Cost (Kshs)**	**Amount requested (Kshs)**
Tree seedlings production	No	1,500,000.00	5.50	8,250,000.00
Plantation Establishment	Ha	31.00	22,194.00	688,014.00
Natural Forests Rehabilitation	Ha	130.00	22,194.00	2,885,220.00
Commercial farm forests establishment	Ha	500.00	14,400.00	7,200,000.00
Bamboo seedling production	No	1,530.00	9.00	13,770.00
Rehabilitation and Maintenance of Forest Roads	Km	52.00	50,000.00	2,600,000.00
Silvicultural Treatment (Pruning)	Ha	700.00	8,220.00	5,754,000.00
Total Amount requested for the activities	Kshs			27,391,004.00
Total amount allocated for the activities	Kshs			25,000,000.00
Constraints	**Unit**	**Target**	**Unit Cost (Kshs)**	**Cost (Kshs)**
Raw material (Polythene tube for tree seedling production)	No	1,500,000	0.8	1,200,000.00
Raw material (Polythene tube for Bamboo seedling production)	No	1,530	1.6	2,448.00
Labour (Plantation establishment)	Ha	31	22,194	688,014.00
Labour (Natural Forest establishment)	Ha	130	22,194	2,885,220.00
Labour (Commercial farm forests establishment)	Ha	500	14,400	7,200,000.00

Labour (Silvicultural Treatment)	Ha	700	8,220	5,754,000.00
Machine operation	Km	52	50,000	2,600,000.00

County 11: Bungoma				
Activity	**Unit**	**Target**	**Unit Cost (Kshs)**	**Amount requested (Kshs)**
Tree seedlings production	No	1,500,000.00	5.50	8,250,000.00
Plantation Establishment	Ha	450.00	22,194.00	9,987,300.00
Natural Forests Rehabilitation	Ha	400.00	22,194.00	8,877,600.00
Bamboo seedling production	No	300.00	9.00	2,700.00
Rehabilitation and Maintenance of Forest Roads	Km	45.00	50,000.00	2,250,000.00
Silvicultural Treatment (Pruning)	Ha	50.00	8,220.00	411,000.00
Total Amount requested for the activities	Kshs			29,778,600.00
Total amount allocated for the activities	Kshs			21,000,000.00
Constraints	**Unit**	**Target**	**Unit Cost (Kshs)**	**Cost (Kshs)**
Raw material (Polythene tube for tree seedling production)	No	1,500,000	0.8	1,200,000.00
Raw material (Polythene tube for Bamboo seedling production)	No	300	1.6	480.00
Labour (Plantation establishment)	Ha	450	22,194	9,987,300.00
Labour (Natural forest establishment)	Ha	400	22,194	8,877,600.00
Labour (Silvicultural Treatment)	Ha	50	8,220	411,000.00
Machine operation	Km	45	50,000	2,250,000.00

County 12: Kajiado				
Activity	**Unit**	**Target**	**Unit Cost (Kshs)**	**Amount requested (Kshs)**
Tree seedlings production	No	1,500,000.00	5.50	8,250,000.00
Plantation Establishment	Ha	100.00	22,194.00	2,219,400.00
Natural Forests Rehabilitation	Ha	400.00	22,194.00	8,877,600.00
Rehabilitation and Maintenance of Forest Roads	Km	43.00	50,000.00	2,150,000.00
Silvicultural Treatment (Pruning)	Ha	613.00	8,220.00	5,038,860.00
Total Amount requested for the activities	Kshs			21,497,000.00
Total amount allocated for the activities	Kshs			18,000,000.00
Constraints	**Unit**	**Target**	**Unit Cost (Kshs)**	**Cost (Kshs)**
Raw material (Polythene tube for tree seedling production)	No	1,500,000	0.8	1,200,000.00
Labour (Plantation establishment)	Ha	100	22,194	2,219,400.00
Labour (Natural Forest establishment)	Ha	400	22,194	8,877,600.00
Labour (Silvicultural Treatment)	Ha	613	8,220	5,038,860.00
Machine operation	Km	43	50,000	2,150,000.00

County 13: Trans Nzoia				
Activity	**Unit**	**Target**	**Unit Cost (Kshs)**	**Amount requested (Kshs)**
Tree seedlings production	No	1,000,000.00	5.50	5,500,000.00
Plantation Establishment	Ha	500.00	22,194.00	11,097,000.00
Natural Forests Rehabilitation	Ha	100.00	22,194.00	2,219,400.00

Bamboo seedling production	No	900.00	9.00	8,100.00
Rehabilitation and Maintenance of Forest Roads	Km	70.00	50,000.00	3,500,000.00
Silvicultural Treatment (Pruning)	Ha	490.00	8,220.00	4,027,800.00
Total Amount requested for the activities	Kshs			26,352,300.00
Total amount allocated for the activities	Kshs			25,000,000.00
Constraints	**Unit**	**Target**	**Unit Cost (Kshs)**	**Cost (Kshs)**
Raw material (Polythene tube for tree seedling production)	No	1,000,000	0.8	800,000.00
Raw material (Polythene tube for Bamboo seedling production)	No	900	1.6	1,440.00
Labour (Plantation establishment)	Ha	500	22,194	11,097,000.00
Labour (Natural Forest establishment)	Ha	100	22,194	2,219,400.00
Labour (Silvicultural Treatment)	Ha	490	8,220	4,027,800.00
Machine operation	Km	70	50,000	3,500,000.00

County 14: Migori				
Activity	**Unit**	**Target**	**Unit Cost (Kshs)**	**Amount requested (Kshs)**
Tree seedlings production	No	1,000,000.00	5.50	5,500,000.00
Plantation Establishment	Ha	30.00	22,194.00	665,820.00
Commercial farm forests establishment	Ha	800.00	14,400.00	11,520,000.00
Rehabilitation and Maintenance of Forest Roads	Km	32.00	50,000.00	1,600,000.00
Silvicultural Treatment (Pruning)	Ha	30.00	8,220.00	246,600.00
Total Amount requested for the activities	Kshs			19,532,420.00

Total amount allocated for the activities	Kshs			18,000,000.00
Constraints	**Unit**	**Target**	**Unit Cost (Kshs)**	**Cost (Kshs)**
Raw material (Polythene tube for tree seedling production)	No	1,000,000	0.8	800,000.00
Labour (Plantation establishment)	Ha	30	22,194	665,820.00
Labour (Commercial farm forests establishment)	Ha	800	14,400	11,520,000.00
Labour (Silvicultural Treatment)	Ha	30	8,220	246,600.00
Machine operation	Km	32	50,000	1,600,000.00

County 15: Siaya				
Activity	**Unit**	**Target**	**Unit Cost (Kshs)**	**Amount requested (Kshs)**
Tree seedlings production	No	1,000,000.00	5.50	5,500,000.00
Natural Forests Rehabilitation	Ha	30.00	22,194.00	665,820.00
Commercial farm forests establishment	Ha	900.00	14,400.00	12,960,000.00
Bamboo seedling production	No	500.00	9.00	4,500.00
Total Amount requested for the activities	Kshs			19,130,320.00
Total amount allocated for the activities	Kshs			18,000,000.00
Constraints	**Unit**	**Target**	**Unit Cost (Kshs)**	**Cost (Kshs)**
Raw material (Polythene tube for tree seedling production)	No	1,000,000	0.8	800,000.00
Raw material (Polythene tube for Bamboo seedling production)	No	500	1.6	800.00
Labour (Natural Forest establishment)	Ha	85	22,194	1,886,490.00
Labour (Commercial farm forests establishment)	Ha	750	14,400	10,800,000.00

County 16: Nandi				
Activity	**Unit**	**Target**	**Unit Cost (Kshs)**	**Amount requested (Kshs)**
Tree seedlings production	No	1,500,000.00	5.50	8,250,000.00
Plantation Establishment	Ha	480.00	22,194.00	10,653,120.00
Natural Forests Rehabilitation	Ha	43.00	22,194.00	954,342.00
Commercial farm forests establishment	Ha	500.00	14,400.00	7,200,000.00
Bamboo seedling production	No	3,000.00	9.00	27,000.00
Rehabilitation and Maintenance of Forest Roads	Km	62.00	50,000.00	3,100,000.00
Silvicultural Treatment (Pruning)	Ha	226.00	8,220.00	1,857,720.00
Total Amount requested for the activities	Kshs			32,042,182.00
Total amount allocated for the activities	Kshs			29,000,000.00
Constraints	**Unit**	**Target**	**Unit Cost (Kshs)**	**Cost (Kshs)**
Raw material (Polythene tube for tree seedling production)	No	1,500,000	0.8	1,200,000.00
Raw material (Polythene tube for Bamboo seedling production)	No	3,000	1.6	4,800.00
Labour (Plantation establishment)	Ha	480	22,194	10,653,120.00
Labour (Natural Forest establishment)	Ha	43	22,194	954,342.00
Labour (Commercial farm forests establishment)	Ha	500	14,400	7,200,000.00
Labour (Silvicultural Treatment)	Ha	226	8,220	1,857,720.00
Machine operation	Km	62	50,000	3,100,000.00

County 17: Meru				
	Unit	**Target**	**Unit Cost (Kshs)**	**Amount requested (Kshs)**
Tree seedlings production	No	1,000,000.00	5.50	5,500,000.00
Plantation Establishment	Ha	550.00	22,194.00	12,206,700.00
Natural Forests Rehabilitation	Ha	110.00	22,194.00	2,441,340.00
Commercial farm forests establishment	Ha	200.00	14,400.00	2,880,000.00
Bamboo seedling production	No	1,000.00	9.00	9,000.00
Rehabilitation and Maintenance of Forest Roads	Km	62.00	50,000.00	3,100,000.00
Total Amount requested for the activities	Kshs			26,137,040.00
Total amount allocated for the activities	Kshs			25,000,000.00
Constraints	**Unit**	**Target**	**Unit Cost (Kshs)**	**Cost (Kshs)**
Raw material (Polythene tube for tree seedling production)	No	1,500,000	0.8	1,200,000.00
Raw material (Polythene tube for Bamboo seedling production)	No	3,000	1.6	4,800.00
Labour (Plantation establishment)	Ha	480	22,194	10,653,120.00
Labour (Natural Forest establishment)	Ha	43	22,194	954,342.00
Labour (Commercial farm forests establishment)	Ha	500	14,400	7,200,000.00
Labour (Silvicultural Treatment)	Ha	226	8,220	1,857,720.00
Machine operation	Km	62	50,000	3,100,000.00

APPENDIX VII: DATA ENTRY TABLE SAMPLE FOR LINEAR PROGRAMMING USING L&IP SOFTWARE: KAKAMEGA COUNTY

Variable -->	X1	X2	X3	X4	X5	X6	X7	Direction	R. H. S.
Maximize	5,500,000	6,658,200	1,886,490	10,800,000	9,000	2,400,000	5,038,860		
C1	5.5	22,194	22,194	14,400	9	50,000	8,220	<=	29,000,000
C2	0.8				1.6			<=	801,600
C3		22,194	22,194	14,400			8,220	<=	24,383,550
C4						1		<=	2,400,000
C5	1							>=	0
C6		1						>=	0
C7			1					>=	0
C8				1				>=	0
C9					1			>=	0
C10						1		>=	0
C11							1	>=	0
C12								<=	
LowerBound	0	0	0	0	0	0	0		
UpperBound	M	M	M	M	M	M	M		
VariableType	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous		

APPENDIX VIII: RECOMMENDATION OF RESEARCH CLEARANCE

University of Eldoret
Home of knowledge and innovation

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E-mail: vc@uoeld.ac.ke
Website: www.uoeld.ac.ke

SCHOOL OF NATURAL RESOURCE MANAGEMENT
Department of Forestry & Wood Science

REF: UoE/B/FWS/SDC/026 **DATE:** 14th May, 2019

The Chief Executive Officer
National Commission for Science, Technology and Innovation(NACOSTI)
P.O. Box 26036 – 00100
NAIROBI

SUBJECT: **RECOMMENDATION FOR RESEARCH CLEARANCE- MR. OGILO MAURICE OUMA (ADM. NO. SNAT/FWS/PHD/001/16)**

I write in support of Mr. Ogilo Maurice Charles' application for research clearance from National Commission for Science, Technology and Innovation (NACOSTI).

The applicant is a registered PhD student in the Department of Forestry and Wood Science, School of Natural Resource Management, University of Eldoret. He has completed course work and successfully defended his research proposal titled *''Impact of Corporate Planning and Budget System Optimization on Performance Improvement in Forest Sector, Kenya''*.

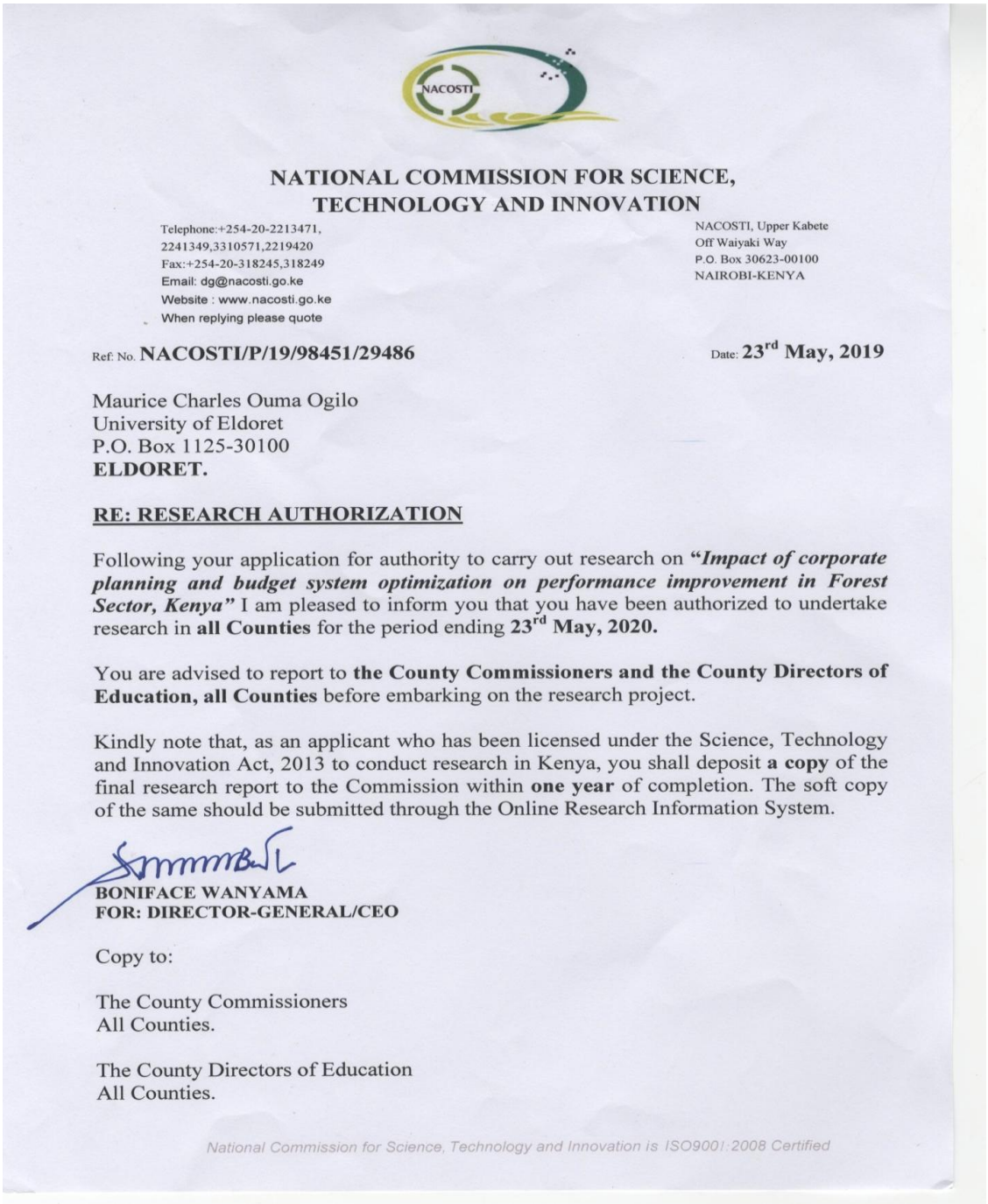
I therefore, support his application for research clearance from NACOSTI.

UNIVERSITY OF ELDORET
Yours faithfully
16 MAY 2019
Forestry & Wood Science Dept.
05-2019

DR. K. O. ODHIAMBO
HEAD, DEPARTMENT OF FORESTRY & WOOD SCIENCE

Copy to: Director, Board of Post Graduate Students
Dean, School of Natural Resource Management
Chairman, Departmental Graduate Committee (DGC)

APPENDIX IX: RESEARCH AUTHORIZATION PERMIT



NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

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Fax:+254-20-318245,318249
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Website : www.nacosti.go.ke
When replying please quote

NACOSTI, Upper Kabete
Off Waiyaki Way
P.O. Box 30623-00100
NAIROBI-KENYA

Ref: No. **NACOSTI/P/19/98451/29486**

Date: **23rd May, 2019**

Maurice Charles Ouma Ogilo
University of Eldoret
P.O. Box 1125-30100
ELDORET.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"Impact of corporate planning and budget system optimization on performance improvement in Forest Sector, Kenya"*** I am pleased to inform you that you have been authorized to undertake research in **all Counties** for the period ending **23rd May, 2020.**

You are advised to report to **the County Commissioners and the County Directors of Education, all Counties** before embarking on the research project.

Kindly note that, as an applicant who has been licensed under the Science, Technology and Innovation Act, 2013 to conduct research in Kenya, you shall deposit **a copy** of the final research report to the Commission within **one year** of completion. The soft copy of the same should be submitted through the Online Research Information System.

BONIFACE WANYAMA
FOR: DIRECTOR-GENERAL/CEO

Copy to:

The County Commissioners
All Counties.

The County Directors of Education
All Counties.

National Commission for Science, Technology and Innovation is ISO9001:2008 Certified

THIS IS TO CERTIFY THAT:
MR. MAURICE CHARLES OUMA OGILO
of UNIVERSITY OF ELDORET, 0-100
NAIROBI,has been permitted to conduct
research in *All Counties*
on the topic: *IMPACT OF CORPORATE PLANNING AND BUDGET SYSTEM OPTIMIZATION ON PERFORMANCE IMPROVEMENT IN FOREST SECTOR, KENYA*
for the period ending:
23rd May,2020

Permit No : NACOSTI/P/19/98451/29486
Date Of Issue : 23rd May,2019
Fee Recieved :Ksh 2000

.....
Applicant's Signature

.....
Director General
National Commission for Science, Technology & Innovation

THE SCIENCE, TECHNOLOGY AND INNOVATION ACT, 2013

The Grant of Research Licenses is guided by the Science, Technology and Innovation (Research Licensing) Regulations, 2014.

CONDITIONS

1. **The License is valid for the proposed research, location and specified period.**
2. **The License and any rights thereunder are non-transferable.**
3. **The Licensee shall inform the County Governor before commencement of the research.**
4. **Excavation, filming and collection of specimens are subject to further necessary clearance from relevant Government Agencies.**
5. **The License does not give authority to transfer research materials.**
6. **NACOSTI may monitor and evaluate the licensed research project.**
7. **The Licensee shall submit one hard copy and upload a soft copy of their final report within one year of completion of the research.**
8. **NACOSTI reserves the right to modify the conditions of the License including cancellation without prior notice.**

National Commission for Science, Technology and innovation
P.O. Box 30623 - 00100, Nairobi, Kenya
TEL: 020 400 7000, 0713 788787, 0735 404245
Email: dg@nacosti.go.ke, registry@nacosti.go.ke
Website: www.nacosti.go.ke

REPUBLIC OF KENYA

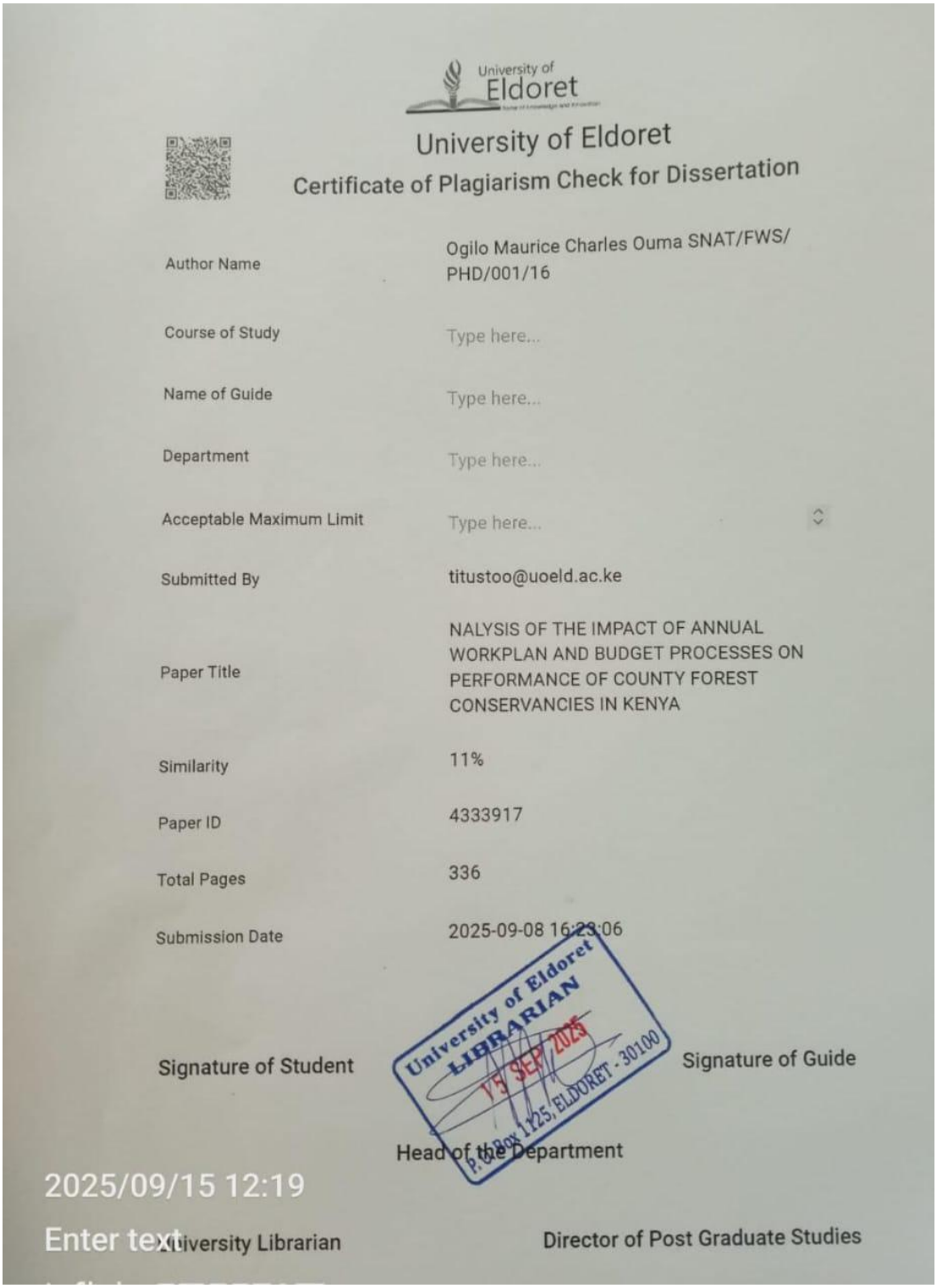
National Commission for Science, Technology and Innovation

RESEARCH LICENSE

Serial No.A 24738

CONDITIONS: see back page

APPENDIX X: SIMILARITY REPORT



University of Eldoret

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Certificate of Plagiarism Check for Dissertation

Author Name	Ogilo Maurice Charles Ouma SNAT/FWS/ PHD/001/16
Course of Study	Type here...
Name of Guide	Type here...
Department	Type here...
Acceptable Maximum Limit	Type here...
Submitted By	titustoo@uoeld.ac.ke
Paper Title	NALYSIS OF THE IMPACT OF ANNUAL WORKPLAN AND BUDGET PROCESSES ON PERFORMANCE OF COUNTY FOREST CONSERVANCIES IN KENYA
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