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Correlation between Funds Allocation and Performance of County Forest Conservancies Against Their Performance Contracts Targets as Indicated in Their AWP&B Using Feasible Model in the Optimization in Kenya

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Abstract:
Annual Workplan and Budget (AWP&B) are prepared annually by public organization as required by the government policy for funds allocation by the treasury which presents a focused role and a determined direction that estimates organization finances against her activities in a financial year. This study analyzed the effect of AWP&B on the performance of County Forest Conservancies (CFCs) in Kenya. Specifically, the study derived a correlation between funds allocation and the performance of CFCs. A descriptive research design was employed to analyze the AWP&B on the performance of CFCs. The result of the correlation between funds allocation and performance of CFCs with the application of the Linear Programming (LP) model of optimization provided optimal solution on performance that will lead to lasting output, especially the allocation of enough funds for better implementation of the activities towards the achievement of planned targets. In conclusion, funds allocation and performance of CFCs correlated with established constraints of budget, raw materials cost, labour cost, and machine operation cost due to limited fund allocation, which had a negative effect on performance in terms of the level of activities done. LP model clearly provided optimal solutions to the viability of carrying out seedling production and other activities in the counties. To this effect, the LP model is to be enhanced to help the organizations optimize decisions on variables to solve problems of limited resources and multiple objectives incurred when implementing AWP&B.

Keywords: *AWP&B, conformity, evaluation, formulation, fund allocation, linear programming and performance*

1. Introduction

Globally, forestry is crucial to the lives of millions of people, especially the poorest of society, who most critically depend on forest resources for their well-being and survival (FAO, 2016). In Kenya, 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, 2016).

According to GOK (2018), it employs over 50,000 people directly and another 300,000 indirectly. 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 good governance structures and policies that enhance the effective and efficient delivery of services.

Savingnon et al. (2019) noted that the public budgeting would offer organization the opportunity to promote consistency and reconciliation of budget allocation in the plan and policy priorities.

However, public organizations that desire to transform their budgeting systems need to consider their perceptions regarding the planning and budgeting process (Aliabadi et al., 2019). Annual Work Plan and Budget (AWP&B) implemented by organizations therefore present a focus, role and a clearly determined direction to enhance the work performance. In Kenya, Kenya Forest Service (KFS) prepares its AWP&B as required by the treasury guideline stipulated in the Medium Term Budget (MTB) process for funds allocation from the exchequer. According to GOK, the 2023 work planning structure supports MTB's negotiation of funds anchored on the Medium-Term Plan (MTP) of Vision 2030. As the first step towards accessing the funds, County Forest Conservancies (CFCs), who are the beneficiaries, prepare their AWP&B 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 due to less money given to KFS.

1.1. Problem Statement

CFCs have not been able to implement all planned activities as stipulated in their committed PC targets. Over the last 10 years, the budgetary requirement for the KFS strategic plan was Kshs 91.539 billion to effectively realize the implementation of the activities. Based on the approved budget, the amount available was only Kshs 56.849 billion, leaving a deficit of Kshs 34.751 billion.

A factor that has prevented the full implementation of planned activities is less money because of the absence of a strong enabling amalgamated AWP&B structure of KFS to negotiate for more funds from the exchequer. The study intends to resolve the problem by investigating the AWP&B on performance delivery with a view to improving it for adequate fund allocation.

1.2. Research Objective

To derive a correlation between funds allocation and performance of County Forest Conservancies against their Performance Contracts targets as indicated in their AWP&B using a feasible model in the optimization in Kenya.

1.3. Scope of the Study

The setting of the study was the CFCs since they are state actors implementing the AWP&B.

2. Research Methodology

2.1. Study Area

The study was carried out in seventeen CFCs in Kenya. According to First Schedule Article 6 (1) GOK, 2010, there are 47 counties in Kenya. Since the AWP&B is implemented in all the counties, their total number formed the population of the study considered for evaluation. Figure 1 below is a map of Kenya showing the boundary of the 47 CFCs and the study area.

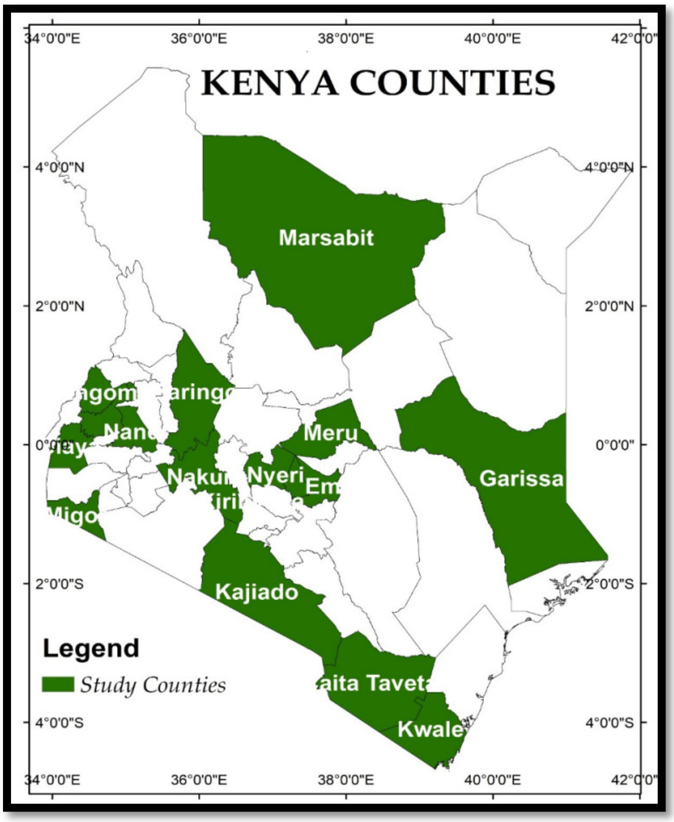

Figure 1: The Study Area of Seventeen CFCs in Kenya

2.2. Research Design

This study employed descriptive statistical research to provide answers to the questions associated with the research problem statement.

The information concerning the AWP&B described ''what exists'' to independent, intervening and dependent variable conditions.

2.3. Population and Sample

The population and sample size were determined by the number of CFCs in Kenya, where AWP&B activities are implemented 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. The total number of counties formed the population of the study area considered for research, and seventeen counties were selected and formed the sample size.

2.4. Sampling Technique and Sample Size

Subject to a sample of the population determination, the study displayed all 47 characteristics of the population in order to be truly representative. Mugenda (2008) argued that for high-precision pilot 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 the 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 follows:

100% = 47 Counties, therefore 36% = (36 X 47)-100 =17 Counties (*Area sampled*)

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	**42**	**43**	**44**	**45**	**46**	**47**	**X**	**X**	**X**

Table 1: Sampling Units Area Showing the Digits of 47 Counties

Table 1 above shows the characters of the digits of the sampling unit area of the 47 CFCs in Kenya. The 17 sampling unit areas of CFCs determined from the above calculation were further stratified according to ten Regional Forest Conservancies (RFCs): 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 was selected in each of the RFCs with the smallest number of counties, as shown in table 2 below:

Regional Forest Conservancy	Counties	Sampled Counties
1. Nyanza	Kisii	
	Migori	Migori
	Siaya	Siaya
	Kisumu	
	Nyamira	
	Homabay	
2. Central Highland	Laikipia	
	Kiambu	
	Murang'a	
	Kirinyaga	Kirinyaga
	Nyandarua	
	Nyeri	Nyeri
3. Nairobi	Nairobi	
	Kajiado	Kajiado
4. Coast	Kwale	Kwale
	Lamu	
	Mombasa	
	Tana River	
	Taita Taveta	Taita Taveta
	Kilifi	
5.Western	Bungoma	Bungoma
	Kakamega	Kakamega
	Vihiga	
	Busia	
6. North Eastern	Garissa	Garissa
	Wajir	
	Mandera	
7. Eastern	Embu	Embu
	Meru	Meru
	Tharaka Nithi	
	Machakos	
	Makueni	
	Kitui	
8. North Rift	Nandi	Nandi
	Trans Nzoia	Trans Nzoia
	Uasin Gishu	
	West Pokot	
	Turkana	
	Elgeyo Marakwet	

Regional Forest Conservancy	Counties	Sampled Counties
9. Mau	Baringo	Baringo
	Nakuru	Nakuru
	Narok	
	Kericho	
	Bomet	
10. Ewaso North	Marsabit	Marsabit
	Samburu	
	Isiolo	

Table 2: Sampled Counties in the Regional Forest Conservancy

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

2.5. Data Collection

Primary data was sourced from a structured questionnaire with 12 major activities implemented by CFCs to realize the KFS strategic plan and secondary data was sourced from government policy documents, circulars, reports, returns books, and journal publications. The data were presented using tables and figures.

2.6. Data Analysis and Presentation

Data analysis for a correlation between funds allocation and performance of CFCs was done using the Linear Programming (LP) model to determine the optimization solution of fund allocation and performance. 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. The outcome of the LP model was 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 was linear, which made it computationally tractable. System variances were considered to measure the CFC's ability to absorb the allocated funds to implement the AWP&B activities, timely recognition of problems and optimization to enhance work performance.

3. Results and Discussion

The table 3 below shows the results of budgetary requirement of activities implemented by the CFCs against total amount of funds allocated in 2021/2022 FY.

No.	CFCs	No. of Activities Implemented	Total Amount Requested for the Activities (Kshs)	The Total Amount Allocated for the Activities (Kshs)
1	Kakamega	7	3,22,92,550	2,90,00,000
2	Garissa	3	1,20,29,540	1,10,00,000
3	Marsabit	3	1,63,47,000	1,40,00,000
4	Nakuru	5	1,76,03,738	1,10,00,000
5	Baringo	4	1,63,60,800	1,10,00,000
6	Nyeri	4	1,89,20,560	1,40,00,000
7	Taita Taveta	2	17,26,450	7,00,000
8	Kwale	5	1,58,16,500	1,40,00,000
9	Embu	6	2,27,39,920	2,10,00,000
10	Kirinyaga	7	2,73,91,004	2,50,00,000
11	Bungoma	6	2,97,28,600	2,10,00,000
12	Kajiado	5	2,14,97,000	1,80,00,000
13	Trans Nzoia	6	2,63,52,300	2,50,00,000
14	Migori	5	1,95,32,420	1,80,00,000
15	Siaya	4	1,91,30,320	1,80,00,000
16	Nandi	7	3,20,42,182	2,90,00,000
17	Meru	6	2,61,37,040	2,50,00,000
Total		85	35,56,47,924	30,47,00,000

Table 3: Budgetary Requirement against Total Amount of Funds Allocated for Activities

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).

3.1. Feasible Models for the AWP&B System Optimization

In the model, the system essentially seeks to minimize the total fixed and variable costs to the work performance of the CFCs activities. 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, the linear programming (LP) model was used to determine an optimization solution for fund allocation and performance, with the assumption that relationships between variables are linear, which makes it computationally tractable.

Note 1: Every optimization problem had three components:

- An objective function
- Decision variables
- Constraints

Note 2: Characteristics of Linear programming problems:

- A decision amongst alternative courses of action is required.
- The decision is represented in the model by decision variables.
- The problem encompasses a goal, expressed as an objective function that the decision-maker wants to achieve.
- Restrictions (represented by constraints) exist that limit the extent of achievement of the objective.
- The objective and constraints must be definable by linear mathematical functional relationships.

Note 3: Properties of Linear Programming models:

- Proportionality – The rate of change (slope) of the objective function and constraint equations is constant.
- Additivity – Terms in the objective function and constraint equations must be additive.
- Divisibility – Decision variables can take on any fractional value and are therefore continuous as opposed to integer in nature.
- 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 a CFC below were realized:

3.2. Problem Statement for Feasible Models for the AWP&B System Optimization for the County

- To produce 1,000,000 tree seedlings with a unit cost of Kshs 5.50 per tree seedling production.
- To establish 300 ha of plantations with a unit cost of Kshs 22,194.00 per hectare of the establishment.
- To rehabilitate 85 ha of natural forests with a unit cost of Kshs 22,194.00 per hectare of rehabilitation.
- To establish 750 ha of commercial farm forests with a unit cost of Kshs 14,400.00 per hectare of the establishment.
- To produce 1,000 bamboo seedlings with a unit cost of Kshs 9.00 per bamboo seedling production.
- To rehabilitate and maintain 48 km of forest roads with a unit cost of Kshs 50,000.00 per kilometre of rehabilitation and maintenance.
- To do a silvicultural treatment (Pruning) of 613Ha with a unit cost of Kshs 8,220.00 per hectare of silvicultural treatment.
- To determine the optimal solution of activities viable to be implemented in the county that minimizes the costs and increases the level of satisfaction of performance.

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, and X7 are decision 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 Sylviccultural treatment (Pruning), respectively.
The coefficient of X1, X2, X3, X4, X5, X6, and X7 are the unit cost of the decisions 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

Table 4: LP Model Optimization Formulation and Solution

Table 4 above shows the results of LP model optimization formulation and solution. It provides identified objective function with seven (7) decision variables and eleven (11) constraints and explicitly stated the non-negativity restriction used for writing down the optimization model.

	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

Table 5: Results of LP Model 1, Solved Using L&IP Software

The results of L&IP are shown in table 5 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 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. This means that if these values are added to the correspondent parameter values on the objective function, these activities will be viable to implement. The shadow cost of the other constraints is zero. However, the one-unit changes of these constraints do not affect the implementation of these activities.

The slack variables introduced into the linear constraints of LP were identified as positive for the 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.

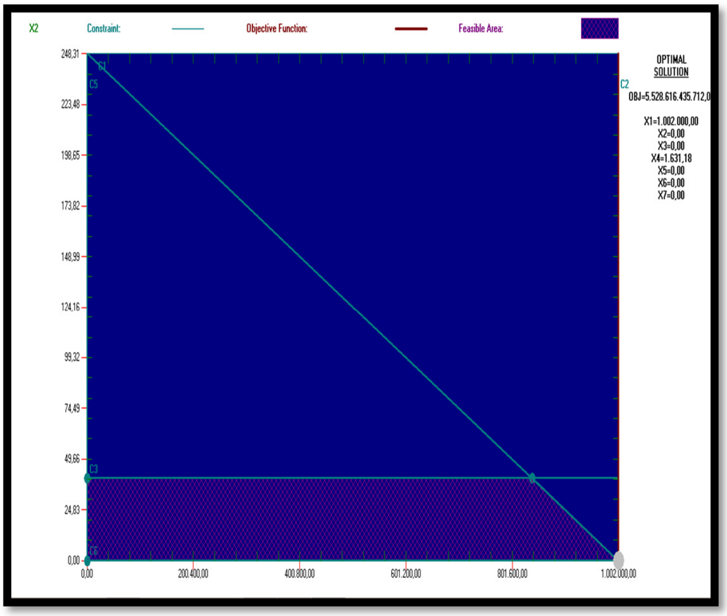

Figure 2: Graphical Solution of LP Model Showing Feasible Region

Figure 2 above shows the Graphical solution of the LP model. The results show the visualized region shaded providing an optimal solution with the objective function value of maximization equal to Kshs 5,528,616,435,712.00, X1 equal to Kshs 1,002,000.00, X2 equals 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 and all values the model takes in the optimization, as shown in figure 2 above. The feasible solution region on the graph is one that is satisfied by the constraints, viewed as the intersection of the 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 to the equation of the objective function. This process proves the optimal solution to the problem, as indicated on the left side of the graph above.

The values of the basic variables keep 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 the allocation of enough funds for better implementation of the activities towards the achievement of planned targets.

Data analysis using the LP model showed that some of the activities had a strong link to budget gaps and requirements. 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 significant correlations noted between performance, budget allocation, and requirement lend credence to the observations in the LP model, which show that some activities presented strong ties between the dependent variable and the two predictors.

4. Conclusion

The descriptive analysis investigating the derived correlation between funds allocation and performance of CFCs with the application of the 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 the performance of the CFCs in terms of the level of major activities done. The study noted that LP is a versatile tool with real-world applications across various domains. Its ability to solve complex optimization problems makes it invaluable for businesses and organizations seeking efficient and cost-effective solutions.

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 a need to enforce the legislative system with regard to resource allocation to enable CFCs to achieve their PC targets as planned in the FFYs. The CFCs can realize a greater level of performance from the allocated funds by focusing greater efforts on tree seedling production, plantation establishment and Bamboo seedling production, as these present a marked sensitivity to budgetary allocation.

Engaging and securing increased funding from the government, there is a need to enforce the legislative system with regard to resource allocation to enable CFCs to achieve their PC targets as planned in the FFYs. In an 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 the budget as a planning and control tool for management be relooked at to introduce KPI into the AWP&B, which can be accepted without any hindrances towards improving work performance.

5. Recommendation

The LP model clearly provided optimal solutions to the viability of carrying out seedling production and other activities in the counties. To this effect, the LP model should be enhanced to help organizations optimize decisions on variables to solve problems of limited resources and multiple objectives incurred when implementing AWP&B.

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