



# Evaluating the Sustainability of Incentive-based Conservation: A Case Study of the Taungya System in the Mount Elgon Conservation Area, Uganda

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## Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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## ABSTRACT

This study evaluates the sustainability of the Taungya system, an incentive-based conservation approach implemented in the Mount Elgon Conservation Area, Uganda. The system integrates reforestation with agricultural practices, aiming to balance biodiversity conservation and local

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community livelihoods. Utilizing a mixed-methods approach, quantitative data from structured surveys of 240 program participants were analyzed using SPSS, while thematic analysis was applied to qualitative insights from key informant interviews. The findings show a 68% increase in vegetation cover, demonstrating the system's positive environmental impact. However, socio-economic benefits were uneven, with 86% of participants both consuming and selling crops, yet 93% reported that the benefits were insufficient to sustain them year-round. Key challenges included insecure land tenure, limited land size, and restrictions on agricultural practices like pruning and spraying. Despite these obstacles, the Taungya system fostered reforestation and community livelihoods, though unresolved land disputes and wildlife interactions contributed to negative perceptions of conservation efforts. These findings highlight important considerations for improving incentive-based conservation models, including the need for policy reforms that secure land tenure, expand land allocations, and support sustainable agricultural practices. The broader implications suggest that similar models in tropical regions can benefit from incorporating local needs into conservation goals to ensure long-term success.

*Keywords: Incentive-based conservation; taungya system; sustainable agroforestry; mount elgon conservation area; community livelihoods.*

## 1. INTRODUCTION

The sustainability of conservation efforts in regions where biodiversity is under threat from human activities has become a critical area of study. Protected areas (PAs) have long served as a cornerstone in efforts to preserve biodiversity and maintain natural landscapes globally. Historically focused on safeguarding rare and endangered species, these areas have evolved to play broader roles, extending ecological services that benefit both local communities and society at large [1,2,3]. This evolution reflects a deeper understanding of the intricate links between ecological health and human well-being, acknowledging that effective conservation must integrate human activity sustainably rather than excluding it outright.

Despite their ecological benefits, the creation and management of protected areas often come with significant socio-economic costs. Traditionally, conservation policies have led to displacement, loss of livelihood, and social conflicts, particularly impacting rural communities in developing regions [4,5,6]. These communities frequently bear the consequences of conservation efforts that restrict access to the natural resources upon which they depend, sparking debates about the ethical implications of such exclusionary practices [7].

In response to these challenges, conservation strategies have increasingly adopted incentive-based approaches over the past few decades. These strategies aim to align the objectives of biodiversity conservation with the economic and social well-being of local populations. By linking

the conservation of natural resources directly to community benefits, these models foster a more inclusive approach to environmental stewardship. Examples of such models include community-based conservation (CBC), community-based natural resource management (CBNRM), and integrated conservation and development projects (ICDP), which provide tangible benefits to communities and promote positive attitudes towards conservation [8,9].

One illustrative example of an integrated conservation approach is the Taungya system, an agroforestry practice that combines tree planting with agricultural crop cultivation. This system, which was originally developed in Myanmar in the 19th century and has since been adapted in various tropical regions, allows participating farmers to cultivate food crops between rows of planted trees on forest land [10,11,12,13]. In Uganda's Mount Elgon area, the Taungya system has been implemented as a strategy to achieve dual goals: enhancing forest cover while providing livelihood opportunities for local communities [14].

This study focused on the Mount Elgon Conservation Area to explore how the Taungya system serves as an incentive-based conservation strategy. It assessed the ecological and socioeconomic benefits provided by the system and examined its effectiveness in fostering sustainable conservation practices that support both conservation targets and community livelihood needs. The research investigated the socioeconomic and conservation benefits realized through the Taungya system, the sustainability of these benefits, and the

influence of the program on community attitudes towards conservation.

Employing a mixed-methods approach, this study integrates quantitative data from structured surveys with qualitative insights from interviews and focus groups, allowing for a comprehensive analysis of the Taungya system's impacts. This methodological pluralism captures a wide range of perspectives from various stakeholders, offering a nuanced understanding of the system's effectiveness.

By examining the effectiveness of the Taungya system in the Mount Elgon area, this research contributes to the broader discourse on sustainable conservation practices, aiming to inform policy and practice in similar contexts globally. Through its findings, the study sought to offer actionable recommendations for enhancing the design and implementation of incentive-based conservation strategies, ensuring they more effectively meet the dual goals of ecological preservation and community development.

## 2. METHODOLOGY

Study area, Mount Elgon National Park (MENP) covers an area of about 110,971 ha, located in Eastern Uganda in eight (8) districts stretching between 0° 52' and 1° 25' N and 34° 14' and 34° 44' E. A large portion of the park is in Bukwo (26%), followed by Kween (17%) and Bulambuli (13%). Considering the proportion of the total district area covered by the park, over 50% of Bukwo and more than a third of the Bududa (41%) and Kapchorwa (36%) districts are under protection.

This study utilized a mixed-methods approach, incorporating both qualitative and quantitative research designs, to evaluate the effectiveness of the Taungya conservation program in Mount Elgon National Park, Uganda. The area of study spans across three sub-counties within the park, involving a population of 600 participants engaged in the conservation program. The study population included all participants in the Taungya conservation program in the Kapakwata sub-county in Kapchorwa district spread over 11 villages. A sample of 240 participants was derived using the Yamane formula for determining sample sizes from known population sizes, ensuring representativeness [15]. Data collection was conducted through household surveys for program participants and key informant interviews with Uganda Wildlife Authority staff and other stakeholders. Simple

random sampling was used for general participants, while purposive sampling targeted key informants with specific insights into the program's implementation and outcomes.

Data was analyzed using the Statistical Package for the Social Sciences (SPSS), to generate means, percentages and statistical significance, focusing on variables such as changes in attitudes, income levels, food security, and ecological impacts.

## 3. RESULTS

The effectiveness of the Taungya program in balancing conservation targets with the livelihood needs of the local community around Mount Elgon was examined through a comprehensive analysis of survey data from 240 program participants. Data were processed using SPSS, yielding insights through descriptive statistics, chi-square tests, and cross-tabulation.

### 3.1 Demographic Profile of Respondents

The demographic characteristics of respondents (Table 1) indicated a nearly balanced gender distribution with 51.3% male and 48.7% female participants. The majority of respondents were under the age of 50, with a significant representation across various educational levels: 38.3% with certificates, 36.3% with diplomas, and 25.4% holding degrees. This demographic diversity supports the validity of the responses regarding the impacts of the Taungya system on community livelihoods and conservation efforts.

This Table 1 presents the demographic profile of the 240 respondents participating in the Taungya program, including gender distribution, age bracket, level of education, marital status, number of children, religion, ethnic groups, and household size.

### 3.2 Perceived Benefits of the Taungya Program

An overwhelming majority (99%, Table 2) of participants perceived the program as beneficial, citing improvements in both livelihood and conservation outcomes. This positive perception is reflected in their utilizations of the harvests, with 86% reporting a dual approach of consuming and selling their produce (Table 3). This indicates a predominantly subsistence approach to farming, integrated with some level of commercial activity.

**Table 1. Demographic characteristics of respondents**

Profile	% Male	% Female	
	% (N)	% (N)	% (N)
<b>Gender</b>	51.3% (123)	48.7% (117)	<b>100 (240)</b>
<b>Age Bracket</b>			
20-29	12.9% (31)		12.9
30-39	30.4 % (73)		30.4
40-49	35% (84)		35
50-above	21.6% (52)		21.6
			<b>100</b>
<b>Level of Education</b>			
Certificate	38.3% (92)		38.3
Diploma	36.3% (87)		36.3
Degree	25.4% (61)		25.4
			<b>100</b>
<b>Marital Status</b>			
Married	63.7% (153)		63.7
Single	16.3% (39)		16.3
Divorced	7.1% (17)		7.1
Widow	12.9% (31)		12.9
			<b>100%</b>
<b>Number of children</b>			
1-3	33.7% (81)		33.7
Above 4	57.5% (138)		57.5
None	8.7% (21)		8.7
			<b>100%</b>
<b>Religion</b>			
Muslims	27.5% (66)		27.5%
Catholics	39.1% (94)		39.1%
Anglicans	25.4% (61)		25.4%
Seventh day Adventists	7.9% (19)		7.9%
			<b>100%</b>
<b>Ethnic groups</b>			
Sabins	74.1% (178)		74.1%
Teso	7.1% (17)		7.1%
Bagisu	18.7% (45)		18.7%
			<b>100%</b>
<b>Household member</b>			
1-5	40.8% (98)		40.8
6-10	15.8% (38)		15.8
11-15	43.3% (104)		43.3
			<b>100%</b>

**Table 2. Perceived Benefits of the Taungya Program**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Beneficial	238	99.0	99.0	99.0
	Not Beneficial	2	1.0	1.0	100.0
	<b>Total</b>	240	100.0	100.0	

This Table 2 shows the results of a Chi-Square Test assessing the participants' perception of the Taungya program's benefits, indicating whether they found the program beneficial or not.

This Table 3 illustrates how participants utilized their harvests from the Taungya program, categorizing responses into those who consumed the produce, sold it, or both consumed and sold it.

### 3.3 Economic and Conservation Impact

A critical aspect of the program’s evaluation was the sustainability of its benefits. While 97% of respondents acknowledged receiving benefits beyond crop production (Table 5), a stark 93% reported that these benefits were not sufficient to sustain them throughout the year (Table 6). The economic impacts were further quantified, showing that a substantial 54% of the harvests were sold, which underscores the program’s role in supporting participant livelihoods through market engagement (Table 4).

This Table 4 details the percentage of harvest that participants sold, highlighting the economic impact of the Taungya program on the livelihood of participants.

This Table 5 presents the responses regarding whether participants received any additional benefits from the Taungya program beyond crop production.

This Table 6. shows participants' responses on whether the benefits obtained from the Taungya

program were sufficient to sustain them throughout the year.

### 3.4 Environmental Outcomes

Significant environmental impacts were noted, with an increase in vegetation cover from initial levels upon entering the program. Initially, 49% of respondents started with 0-25% vegetation cover, which dramatically improved over time with 68% reporting 51-75% cover later (Tables 7 and 8). This progression highlights the Taungya system's effectiveness in enhancing forest cover while engaging community participation.

This Table 7 presents the estimated percentage of vegetation cover reported by participants before they began planting trees as part of the Taungya program.

This Table 8 displays the estimated percentage of current vegetation cover as reported by participants after their involvement in the Taungya program, indicating the environmental impact of the program.

**Table 3. Utilization of Harvest from the Taungya Program**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Consume	7	3.0	3.0	89.0
	Sell	26	11.0	11.0	100.0
	Both	206	86.0	86.0	86.0
<b>Total</b>		<b>240</b>	<b>100.0</b>	<b>100.0</b>	

**Table 4. Percentage of Harvest Sold by Participants**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		5	2.0	2.0	2.0
	Less than 50%	2	1.0	1.0	3.0
	Above 50%	103	43.0	43.0	46.0
	100%	130	54.0	54.0	100.0
<b>Total</b>		<b>240</b>	<b>100.0</b>	<b>100.0</b>	

**Table 5. Additional Benefits Obtained from the Taungya Program**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	7	3.0	3.0	3.0
	Yes	233	97.0	97.0	100.0
<b>Total</b>		<b>240</b>	<b>100.0</b>	<b>100.0</b>	

**Table 6. Sustainability of Benefits from the Taungya Program**

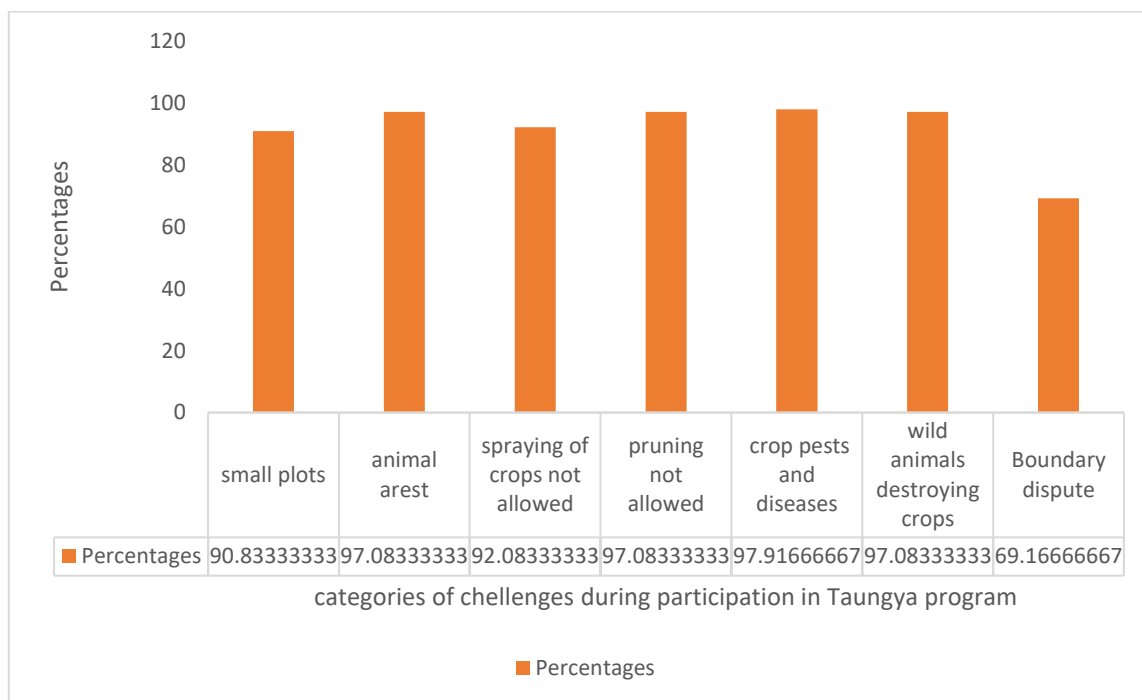
		Frequency	Percent	Valid Percent	Cumulative Percent
	No	223	93.0	93.0	93.0
	Yes	17	7.0	7.0	100.0
<b>Total</b>		<b>240</b>	<b>100.0</b>	<b>100.0</b>	

**Table 7. Estimated Vegetation Cover Before Program Participation**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-25%	118	49.0	49.0	49.0
	26-50%	86	36.0	36.0	85.0
	51-75%	19	8.0	8.0	93.0
	76-100%	17	7.0	7.0	100.0
<b>Total</b>		<b>240</b>	<b>100.0</b>	<b>100.0</b>	

**Table 8. Estimated Vegetation Cover After Program Participation**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-25%	5	2.0	2.0	2.0
	26-50%	29	12.0	12.0	14.0
	51-75%	163	68.0	68.0	82.0
	76-100%	43	18.0	18.0	100.0
<b>Total</b>		<b>240</b>	<b>100.0</b>	<b>100.0</b>	



**Fig. 1. Challenges Faced by Participants in the Taungya Program.** This figure illustrates the various challenges encountered by participants during their involvement in the Taungya program, including issues such as crop pests, diseases, small plot sizes, and wildlife interactions

**3.5 Challenges and Recommendations**

Despite the benefits, participants faced several challenges such as crop pests and diseases, small plot sizes, and wildlife interactions, which were prevalent across the community (Fig. 1). The recommendations for improving the program included allowing more land for cultivation, permitting agricultural practices such as pruning and spraying, and initiating more projects to diversify income sources.

**4. DISCUSSION**

The findings from the Mount Elgon study underline the complex interplay between environmental conservation efforts and socioeconomic benefits through the Taungya system. This incentive-based conservation program, originally aimed at balancing biodiversity preservation with the livelihood needs of local communities, has shown both promising and challenging outcomes.

#### 4.1 Sustainability of Incentive-Based Conservation

The sustainability of incentive-based conservation programs like the Taungya system within the Mount Elgon Conservation Area is a complex and multifaceted issue. While the Taungya system has shown some success in promoting reforestation and reducing encroachment on protected areas, its long-term sustainability remains uncertain. This uncertainty is not unique to the Taungya system; other incentive-based models, such as Participatory Forest Management (PFM) in Kenya and Joint Forest Management (JFM) in India, have also yielded mixed results. These programs' success largely depends on the continuous engagement and satisfaction of participating communities. However, this engagement can be compromised by factors such as unclear land tenure, insufficient economic benefits, and conflicts over resource use [16,17].

In the context of Mount Elgon, the effectiveness of the Taungya system is particularly challenged by inadequate land tenure security. This insecurity creates uncertainty among participants, which in turn reduces their long-term commitment to conservation goals. Without secure land tenure, participants are less likely to invest the time and resources needed to achieve sustainable outcomes. Furthermore, the lack of sufficient technical and financial support for participants limits their ability to fully benefit from the system. This shortfall in support can lead to disillusionment, and eventually, withdrawal from the program. Therefore, for incentive-based conservation models like the Taungya system to be sustainable, there must be a stronger emphasis on securing land tenure and providing continuous financial and technical support to participants.

The sustainability of the Taungya system is further compromised by critical barriers that limit its effectiveness. One such barrier is the restricted land size available to participants, which not only limits agricultural output but also constrains the ecological benefits that agroforestry systems are supposed to provide. These benefits rely on adequate space for effective crop-tree synergies, which are difficult to achieve when land is scarce. Additionally, restrictions on agronomic practices such as spraying and pruning further undermine both crop productivity and the sustainability of the system [18]. To address these challenges, policy

adjustments are necessary. Expanding land allocations and revising agronomic restrictions could enhance the ecological and economic benefits of the Taungya system, making it a more viable and sustainable conservation strategy.

In conclusion, while incentive-based conservation programs like the Taungya system offer promising solutions for integrating conservation with community livelihoods, their sustainability hinges on addressing several critical challenges. Securing land tenure, providing continuous support, and revising restrictive policies are essential steps toward ensuring the long-term success of these programs.

#### 4.2 Socio-Economic and Conservation Benefits

Consistent with the objectives of the Taungya system, the program has provided substantial socioeconomic benefits to the communities. Similar to findings in other regions such as Sudan [18] and Nigeria [11,19,20], the introduction of Taungya has addressed critical issues such as underemployment and food security by integrating agricultural activities with forest regeneration. The majority of participants reported improvements in livelihood through enhanced food production and income from selling surplus crops. This aligns with studies like those conducted in Thailand, China and Nigeria, where agroforestry systems similar to Taungya farming significantly contributes to national food requirements and local economies [21,22,23,20].

However, despite these benefits, the sustainability of these gains appears precarious. As observed, the majority of the program benefits did not sustain participants throughout the year, a challenge exacerbated by limited land sizes and suboptimal agricultural practices restricted within the program guidelines. This reflects the findings in broader agroforestry literature that while Taungya can increase immediate food and income sources, its long-term sustainability is contingent on adequate land and resource allocation [24,25,26].

#### 4.3 Environmental Impacts

From a conservation perspective, the program has successfully contributed to forest recovery and biodiversity conservation, which is a significant positive outcome. The increase in vegetation cover, as reported by participants,

signifies ecological recovery and supports the primary conservation aims of the Taungya system. This is critical as ecological benefits also translate to long-term sustainability for the communities through ecosystem services such as improved soil fertility and microclimate regulation [27,11].

#### 4.4 Influence on Community Attitudes

The impact of the Taungya program on community attitudes towards conservation was mixed. While some community members recognized the benefits of conservation, issues such as animal arrests, crop damage by wildlife, and unresolved land disputes have fostered negative perceptions towards conservation efforts. This is consistent with the literature suggesting that while incentive-based approaches can enhance community engagement and support for conservation, they must adequately address conflict and compensation issues to shift community attitudes positively [28,29].

#### 4.5 Policy Implications

The results of this study have significant policy implications, particularly in relation to land tenure reform and community engagement. One of the key barriers to the success of the Taungya system is the lack of secure land tenure for participants, which discourages long-term investment in conservation efforts. Policy reforms that provide clearer and more secure land rights to participants could enhance their commitment to conservation goals and improve the sustainability of the Taungya system. Furthermore, policies that promote greater community engagement in decision-making processes are essential. By involving local communities more directly in the planning and implementation of conservation programs, policymakers can ensure that these programs are more responsive to the needs and priorities of the communities they aim to serve [30,31].

In addition to land tenure reform, there is a need for policies that support sustainable agricultural practices among Taungya system participants. Providing training and resources for sustainable agriculture could help participants achieve better economic outcomes while also contributing to conservation goals. This dual approach could enhance the overall effectiveness of the Taungya system and similar incentive-based conservation models.

#### 4.6 Gender Considerations

The study's findings also underscore the importance of addressing gender disparities in conservation and development programs. While the Taungya system has the potential to benefit both men and women, there are significant barriers that prevent women from fully participating in and benefiting from the program. These barriers include cultural norms that limit women's access to land and resources, as well as a lack of targeted support for women's participation in conservation activities [32].

Addressing these gender disparities is crucial for ensuring that both men and women benefit equitably from incentive-based conservation programs. This could involve implementing policies and practices that specifically target women's needs, such as providing land rights to women, offering training programs that are accessible to women, and promoting women's involvement in decision-making processes [33]. By ensuring that women have equal access to the benefits of conservation programs, policymakers can help to enhance the overall effectiveness of these programs.

#### 5. CONCLUSION

This study highlights the complex dynamics at play in the implementation of incentive-based conservation programs like the Taungya system in the Mount Elgon Conservation Area. While the system has demonstrated potential in achieving reforestation goals and providing socio-economic benefits to local communities, its sustainability remains fragile due to several critical challenges. The issues of insecure land tenure, limited land size, and restrictive agricultural practices undermine the long-term viability of the program, threatening both the ecological and socio-economic gains made thus far. The findings underscore the importance of addressing these challenges through targeted policy interventions. Securing land tenure for participants is essential to fostering long-term commitment to conservation goals, while expanding land allocations and revising restrictive practices can enhance both agricultural productivity and ecological outcomes. Furthermore, the mixed impact on community attitudes towards conservation suggests that more comprehensive strategies are needed to resolve conflicts and improve community engagement.

For the Taungya system and similar incentive-based conservation models to be sustainable,



they must be designed with a deeper integration of local community needs and conservation objectives. This includes not only policy reforms but also the provision of continuous financial, technical, and social support to participants. By doing so, these programs can achieve a more balanced and enduring contribution to both biodiversity conservation and community development, offering valuable lessons for conservation efforts globally.

### DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc have been used during writing or editing of this manuscript. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology.

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### CONSENT

Informed consent was obtained from all participants prior to data collection, ensuring that they were aware of the purpose of the study and their rights as participants. Confidentiality was maintained throughout the study, and participants were assured that their responses would be anonymized in any reports or publications.

### ETHICAL APPROVAL

The study was conducted in accordance with ethical guidelines for research involving human subjects. Ethical approval was obtained from the relevant institutional review board.

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### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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