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CONSERVATION EDUCATION, ALTERNATIVE LIVELIHOOD AND HABITAT RESTORATION: THE BEST STRATEGIES FOR CONSERVATION OF MAGOMBERA FOREST RESERVE.

ABSTRACT

The Magombera forest is a home of endemic and endangered biological species such as Udzungwa red colobus monkey (*Procolobus gordonorum*) and the Magombera chameleon (*Kinyongia magomberae*). However, the forest is facing high threat of disappearing through the resources extraction pressure from adjacent local communities. The project aimed at improving conservation of Magombera forest by involving the adjacent communities through provision of conservation education, restoration initiatives and bee keeping as alternative way of livelihoods. The study revealed that the concept of forest conservation is well supported. Nevertheless, people are extracting resources from the forest for their sustenance. The dependence of the people on the forest is due to lack of alternatives to the forest resources, inability of the people to produce alternatives source of income and little conservation education. The project resulted to a positive community's in the Community having a positive attitude change towards conservation. The improved bee keeping was introduced to the community and successfully adapted. About 89% of indigenous trees planted for restoring the degraded area of the forest survived, only 11% of trees planted could not survive. There is a need to expand the scale of the project by involving many participants particularly youths that showed strong interest in with the project.

Comment [A1]: And will only get worse unless in-forest sustainable harvesting programs are developed with the different natural resource users from the surrounding communities!!!!

Comment [A2]: I believe 'subsistence' is a better word to use than 'sustenance'

Comment [A3]: Adapted or adopted????

Comment [A4]: Explain in the body of the paper if this was undertaken in a mono-culture that is in plots of only one tree species or did the planting attempt to mix the tree species together as in a natural system???

[Redacted]

Keywords: Magombera forest, alternative livelihood, Modern beekeeping, Restoration

1. INTRODUCTION

Habitat degradation will continue to be a major challenging and severe threat to biodiversity conservation all over the World unless deliberate efforts are taken [1]. Various wildlife habitats in Africa have been destroyed, and posing high extinction risks of for many species. According to [2, 24], habitat loss threatens 85% of all species described in the IUCN's (Interational Union for the Consvration of Nature's) Red List. Much of this destruction is attributed to anthropogenic activities [3]. There are hundreds, possibly thousands of empirical studies that show species richness declining with fragment size [4]. Tanzania has lost thousands of hectares of forests through deforestation and degradation arising mainly from anthropogenic factors such as unsustainable harvesting of forest products, bush meat, charcoal making, agriculture expansion, wild fires, urbanization and mining [5]. For instance, Kalunga forest which is among the lowland forests in Kilombero valley have been cleared for agriculture because of their fertile soil and flat terrain [6]. These activities affect ecosystems that are home to many wild species. Magombera forest is among the forests which faces these challenges.

Magombera Forest is part of the Udzungwa ecosystem in the southern end of the Eastern Arc Mountain Range in South-central Tanzania. It is located at about 6km from the Udzungwa Mountains National park [6]. The forest is diverse in terms of flora and fauna. It harbors endemic and endangered species of plants and animals like Leopards, Elephants, Buffaloes, Iringa red Colobus monkey, Magombera chameleon, *Polyalthia verdcourtii* (Huberantha verdcourtii) tree and the large-leaved Memecylon tree [2, 7]. Magombera forest is also the home for other internationally threatened species of plants and animals such as Udzungwa dwarf galago, and hippopotamus. The Forest is also an important place resource for local communities who depend on the adjacent land for rice and sugar farming. The forest provides invaluable ecological services including protection from floods and soil erosion. The canopy of the forest is mostly intact, however limited regeneration and continued forest use threatens the future of the forest. The vegetation is composed of mature trees with closed canopy, saplings, herbs and grasses.

The forest was gazetted in 1955 because of its biodiversity value and water catchment area [6]. Over the years after its gazettement, it has been reduced in size and degraded through encroachment and mainly human activities such as trees cutting, deadwood collection, hunting, poaching, treeS debarking, fishing and wildfires [6]. The conservation value of Magombera Forest first became known in the 1970s and received international news attention through the scientific discovery of a new chameleon species in 2009, the Magombera chameleon (*Kinyongia magomberae*).

Comment [A5]: The first time you use an abbreviation in a paper you should have witten what it stands for: IUCN (Interational Union for the Consvration of Nature's)

Comment [A6]: Your may wish a brief footnote explaining the Red List

Comment [A7]: Put in a brief foortnote explaining why trees are debarked!!

42 After a decade of consultation, planning and cooperation between the Tanzania Forest Services Agency, the Tanzania
43 Forest Conservation Group, local government, communities, the Udzungwa Forest Project (UFP) and the Kilombero
44 Sugar Company, the forest was formally declared as a Nature Forest Reserve on 11th January 2019 [8]

45 Regardless of the ~~important importance~~ of the forest, awareness ~~by adjacent communities is inadequate or~~ concerning
46 the conservation of the forest ~~and its resources, like bee keeping~~ to the local communities adjacent to the forest and the
47 knowledge ~~on sustainable economic utilization of forest like bee keeping are inadequate~~. The little ~~Insufficient~~
48 conservation awareness and ~~insufficient~~ skills in sustainable utilization of the forest has led to ~~the~~ unsustainable utilization
49 of the forest.

50
51 Experience has shown that, alternative livelihoods and awareness ~~to the by~~ local communities through training and
52 ~~applying~~ community-based conservation approaches can reduce ~~the threats to of~~ the forest [9]. In addition, if the local
53 communities are empowered ~~in the sustainable utilization of to~~ sustainably utilize the forest ~~resources~~, they will definitely
54 provide support in ~~conserving~~ the forest ~~conservation~~. As means of ameliorating the ~~human-forest conflict problems from~~
55 ~~human to the forest~~, there is a need to ~~take find~~ a sustainable utilization ~~approach to the forest's natural resources in ways~~
56 ~~that to~~ benefit local communities while conserving the ~~forest~~ [10, 11]. The ~~deforestation threats on the forest comes from~~
57 ~~cutting trees for various uses example building poles, timber, charcoal making, fire wood, and among others, as well as~~
58 ~~and incidences of wildfires that destroyS the forest vegetation and change the ecology as well~~. Therefore, restoration of
59 degraded areas of the Magombera forest through planting of natural ~~trees~~ is also very crucial ~~especially to the areas that~~
60 ~~have been affected by tree cutting~~, and hence this study included both restoration initiatives, provision of sustainable
61 alternative livelihood and conservation education to community member adjacent to the forest. This study therefore aimed
62 at enhancing conservation of Magombera forest through creation of conservation awareness to the local communities
63 neighboring the forest, empowering them through bee keeping project and restoration initiatives to restore degraded areas
64 of the forest.

65 2. MATERIALS AND METHODS

66 2.1 Study area

67 This project took place at Magombera Forest Reserve by involving community members adjacent to the forest. The forest
68 lies about 6km eastwards from the Udzungwa Mountains National park, ~~in Kilombero District, Morogoro Region~~
69 ~~Tanzania (Figure 1)~~. Magombera ~~is~~ composed of a moist forest, swamp forest, dry woodland and grassland. Some

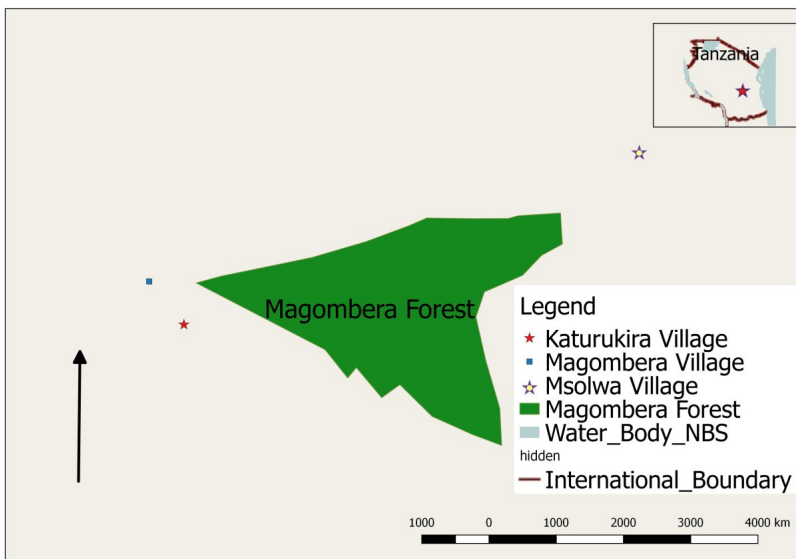
Comment [A8]: Fire is a critical part of Africa's savannas and forested savannas. Our book I recommended you take a look at that goes into this in great detail can be downloaded from ResearchGate goes into this in great detail: DeGeorges, P.A. & Reilly, B.K. 2008. [A critical evaluation of conservation and development in Sub-Saharan Africa: Last Chance Africa](#). The Edwin Mellen Press, Lewiston, New York. 7 books, 3,572p.

I believe you need to state that collaboration will take place to undertake controlled burns both in the forest and on agricultural and grazing lands so as to maintain the ecological integrity of the forest.

Comment [A9]: Have you established a sustainable harvesting program with the local swayers & charcoal makers who earn a living from this??? If not, I fear they will continue illegal harvests, as that is their livelihood!! Doesn't do any good to plant trees if the sawyers/charcoal makers continue cutting with little or no concern for long-term sustainability. You need to show how they were integrated into a sustainable harvesting program in addition to tree planting!!!! Why alternative livelihoods, and why not sustainable existing livelihoods????

Comment [A10]: Doesn't do any good to attempt restoration if there are no long-term plans and integration of the swayers, charcoal makers, traditional hunters, thatch grass collectors, wild food collectors, fishers, etc. Into the sustainable harvest/management of the resources from which they earn a livelihood! If you have not achieved this, you need to note in the paper, it is a priority in the near future!

71 of the tree species are Luke's Cynometra tree (*Cynometra lukei*), Large-leaved Memecyclon tree (*Memecylon sp*) and
 72 Heinsen's Isolona tree (*Isolona heinsenii*), and all of these are endangered. Big mammals such as Elephants,
 73 Buffaloes, Hippopotamus, Duikers and Primates are found in the forest. The climate is of high humidity, annual rainfall
 74 reachings 1500 mm, with an and average temperature of reach 32°C. The forest is bordered by the four villages
 75 namely of Magombera, Kanyenje, Katurukila and Msolwa stesheni. Seventy-five community members from these the
 76 mentioned villages adjacent to the forest were part of involved in the project team. Selection of participants was done
 77 purposely for favored government leaders, villagers who had been were already involved in some bee keeping activities
 78 and students from primary and secondary schools adjacent to the forest.



79 **Figure 1.** Map showing the Magombera Forest and neighbouring villages (source Ngongolo *et al.*, 2019)

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83 **2.2 Methods**

84 **2.2.1 Assessment of the knowledge, and attitudes and practices of people on conservation and improved bee**
 85 **keeping**

86 A list of local communities individuals engaged in some bee keeping from each village adjacent to
 87 the forest was provided by local government leaders. The lists was were entered in the excel
 88 regardless of gender, education level, sex and age. Simple random selection was performed to obtain
 89 the required number of participants from for study in which each village participated.

Comment [A11]: Redundant. You have already stated that these are people from villages adjacent to the forest. No need to say it over and over!!

90 Closed and open-ended questionnaires and direct questions and answers methods were used to assess the knowledge of
91 community members on conservation of the forest and biodiversity in general~~ly~~. Questions were formulated in such a
92 way that can assessed individual's ~~community's~~ awareness about what species are inhabiting Magombera forest, which
93 practices destroy them, why ~~conserving~~ conserve them, and how well to conserve them. Stratified random sampling [12]
94 was used to select participants. Fixed response questions were used to interview the selected participants regarding their
95 attitudes towards conservation, causes of their dependence on the forest and their response towards proposed
96 conservation and alternatives to forest resources.

97 A series of questions were presented and the respondents were asked to agree or disagree. These allow easier
98 interpretation than open-ended questions [13]. Seventy-five Participants responded to pre-prepared questions. For

99 knowledge on improved bee keeping, a questionnaire and closed ended questions were used to assess the knowledge of
100 community members. Participants responded to prepared questions which were in the Swahili language so as to ease
101 understanding. Likert scaling was used to assess the different levels of agreements from respondents where 1=strongly
102 Disagree, 2=Disagree, 3=don't know, 4=Agree and 5=Strongly agree. Friedman Test Statistic was used to test the
103 variation on the understanding of the benefits among the respondents. The variables assessed were knowledge and
104 attitude on conservation and knowledge on beekeeping.

105 2.2.2 Provision of Training

106 The training involved 30 ~~local-adult community members communities~~, 5 local government leaders, 20 primary school
107 pupils and 20 secondary school students. Trainers were qualified personnel from University of Dodoma (UDOM), Save
108 Nature for Life (SANALI), Tanzania Wildlife Research Institute (TAWIRI) and district forest and beekeeping officers. The
109 training was participatory including in-class sessions and field work in the forest. Among others, the training included
110 importance of the forest, threats facing the forest, how to conserve the forest, the-benefits accrued from forest
111 conservation, and bee keeping techniques (e.g., location of apiary, processing, packaging and marketing). In addition,
112 fliers on such topics were prepared in English and the local language (Swahili), and posted in strategic locations in the
113 villages with high public visibility such as the visit-like the dispensary, market, schools, clubs, a church, a mosque, as well
114 as government and NGO offices. The evaluation of effect of training was undertaken that involved asking the same set of
115 questions before and after training. In order to determine the effectiveness of training, the same pre- and post- questions
116 were asked.

118 2.2.3 Tree planting

Comment [A12]: You just stated this in the above paragraph. Is this not unnecessary repetition???

Comment [A13]: No need to continue saying 'LOCAL' - YOU HAVE MADE THIS CLEAR IN EARLIER STATEMENTS. We know all are participants from communities adjacent to the forest!!!

119 Seedlings were planted as part of the practical training. ~~where after~~ After ten months, ~~the~~ a survey was undertaken to
120 determine the number of trees that ~~have~~ survived. Before planting ~~of trees~~, the number of stumps were counted to
121 determine the number of tree cuts. Four ~~random~~ transects ~~each with~~ of 5000 meters each were established ~~was set~~
122 ~~randomly in the forest~~. In each transect 5 plots ~~with the size~~ of 50m² ~~was~~ were chosen at ~~interval of~~ 500m intervals apart.
123 Then the number of stumps per each plot was counted. ~~The species of Trees to be planted~~ was determined by assessing
124 the species ~~makeup in the 5 plots in reference site~~. Six hundred seedlings were planted in the forest. ~~The process of~~
125 planting trees was done in cooperation with the community members.

Comment [A14]: Please explain, did you plant the species randomly in the cutover forest area so as to replicate the natural forest or did you plant in mono-culture plots. If not with species mixed as in a natural setting, please explain why mono-culture plots. It would seem that mixed planting would be best to replicate a natural system!!!

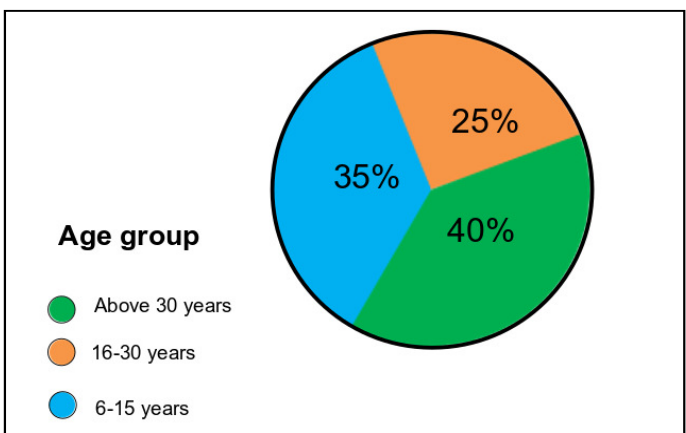
3. RESULTS AND DISCUSSION

3.1 Knowledge and attitude of people on conservation

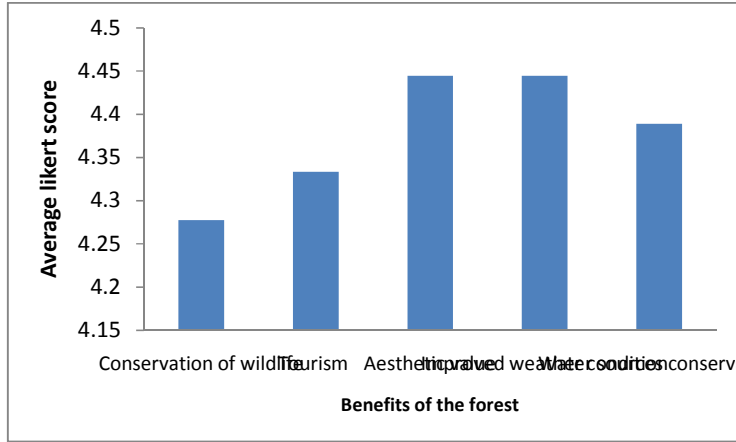
131 Seventy-five people were involved in the assessment. The dominant age in the interviewed cohorts were above 30 while
132 low response was from age group below 30 years (Fig 1). It was observed that most of the participants know how
133 valuable the forest is. About 83% of the participants agreed that the forest has positive value. For instance, participants
134 mentioned values of the forest such as medicinal value and aesthetic value. Likert scaling indicated that participants were
135 knowledgeable and agreed to the benefits accrued by the forest (Fig 2). Variation on the understanding of the benefits
136 among the participants was observed to be statistically insignificant (Friedman Test Statistic = 0.367, $P=0.98$, $df= 4$). The
137 training enabled to raise local communities' knowledge on the values of the forest.

138 Despite the fact that community members had some knowledge on the values of the forest, they had little knowledge on
139 how well to conserve the forest. Moreover, their attitude towards conservation of the forest was negative. There was a
140 positive change of local community members' attitude towards conservation (Fig 3).

Comment [A15]: Maybe you should explain that what has been traditionally imposed upon communities in Africa in the name of Conservation is really Preservation, cutting them off from the resources they need to survive and earn livelihoods- thus alienating communities and turning many into poachers. Your approach appears to be real conservation, involving the communities in sustainable use of 'THEIR' natural resources????????? But then as I read further I have my doubts!!



142 **Figure 1.** Percent of age groups involved in the study.



143
144 **Figure 2.** The likert scaling on the benefit of the Magombera forest. Where by 1-strongly Disagree, 2-Disagree, 3-don't
145 know, 4-Agree, 5-Strongly agree

Comment [A16]: Why did you not ask them about the importance of the key natural resources you have mentioned above that people use for their livelihoods and to take care of themselves – e.g., bushmeat, timber, charcoal, medicine, etc.??? Should this not have been shown in this graph???

148 **3.2 Knowledge on improved bee keeping**

149 Seventy-five community members were participated in the bee keeping project. It was observed that 89% of participants
150 had no knowledge ~~on~~ of improved bee keeping. Among these, 90% were peasants and 10% were students. ~~70% Seventy~~
151 ~~percent of these~~ peasants, ~~who had with~~ no knowledge of ~~on~~ improved bee keeping, were females and 30% were males.
152 Only 11% had ~~little some~~ knowledge ~~on~~ of improved bee keeping. Among these, 74% were students and 26% were
153 peasants. After training, ~~it was observed that~~ the number of participants ~~who got the~~ with improved knowledge of
154 beekeeping ~~was~~ high, ~~as well as improved attitudes towards forest conservation and the level of knowledge to participants~~
155 ~~also increased~~ (Fig 3). All participants engaged in beekeeping project after the training.

Once again, by conservation of wildlife – do you mean sustainable utilization by the local communities as a source of protein and for a few to earn a living, or preservation – no use!!!!????? You need to make this very clear!!!!

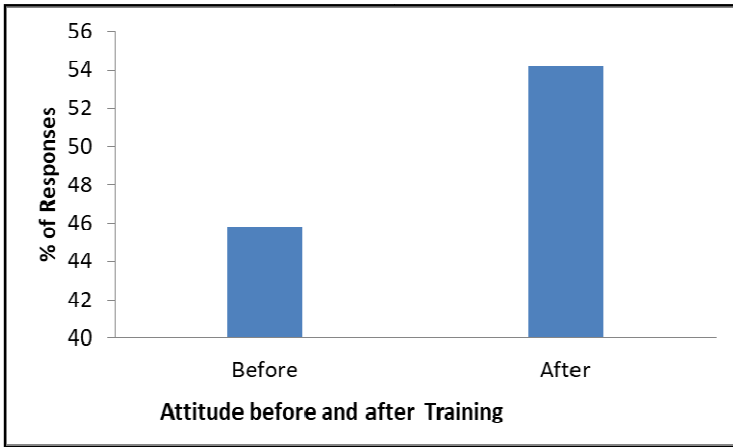


Figure 3. Attitude of people towards conservation of the forest before and after training. The percent of responses were low before training indicating a negative response towards conservation and high response after training indicating positive attitude attitudinal changes.

3.3 Habitat degradation and Restoration initiatives

About 87 stumps were observed, counted and identified. Dominant cutting was observed to *Calycosiphonia spathicalyx* while low cut was observed to *Tricalysia pallens* (Table 1).

Six hundred trees were planted and almost 89% of trees planted survived. ~~grow and proceed well~~ only 11% of trees planted could not survive. (Fig 4). The restoration initiatives were observed to be successful as far as the number of survived surviving trees and the success of their growth is concerned.

Table 1 Number of stumps of trees observed and counted as per tree cuts. The higher the number of the stumps, the higher the level of destruction of the particular species and the higher the demand of local community member on the particular plant species.

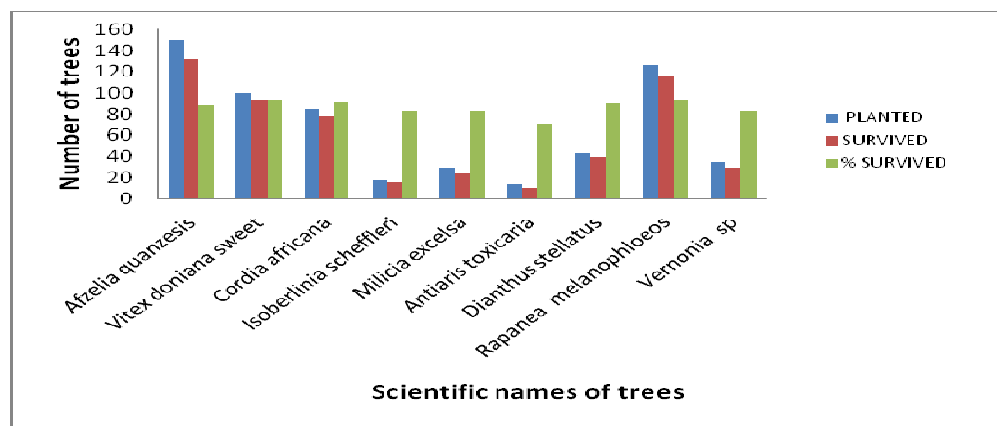
Comment [A17]: Do you have information on the lifecycles of these trees and after how many years can they be harvested as a means of developing sustainable management plans with the local sawyers and charcoal makers!!!! Did you ask by species, what the community use the different trees for and if so, why is this not shown in the paper????

Scientific name	No. of stumps
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<i>Calycosiphonia spathicalyx</i>	28
<i>Erythrophleum suaveolens</i>	17
<i>Isobertinia scheffleri</i>	15
<i>Mallotus oppositifolius</i>	6
<i>Dalbergia melanoxylion</i>	5
<i>Bombax rhodognaphalon</i>	4
<i>Diospyros ferrea</i>	4
<i>Milicia excelsa</i>	3
<i>Cola microcarpa</i>	2
<i>Pachystela brevipes</i>	1
<i>Tabernaemontana pachysiphon</i>	1
<i>Tricalysia pallens</i>	1
Total	87

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173

174 **Figure 4.** Species and number of seedlings planted and their observed survival rates.

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176 4. DISCUSSION

177 4.1 Knowledge and attitude of people on conservation

178 Contrary to the assumptions of many conservationists that rural populations are almost entirely antagonistic to
 179 conservation and ignorant of conservation issues [13], in this study the concept of conserving forests was well supported.

180 'Don't know' responses ~~would have been because of~~ come from mostly impoverished communities that ~~are impoverished~~
 181 ~~and~~ do not have the leeway to support ~~the a particular~~ conservation practice even if they support the concept. As [14] pin

Comment [A18]: Or is this the first time they were involved in true conservation – that is sustainable use. So far you have not discussed the long-term conservation practices you plan for the communities in using the forests resources. I fear what I am seeing is more 'leave the forest alone' and 'solve all the problems on the farm' – once again FAILED INTEGRATED RURAL DEVELOPMENT. If all you have done is attempt to trade off utilization of forest resources for on-the-farm beekeeping you have failed like so many others in Africa. You need to make very clear how the traditional resource users are being involved in developing sustainable harvest management plans for the diversity of resources in the forest used by the community. Planting some trees and introducing modern bee keeping is a minor step in the right direction.

182 points, the real values of conservation (i.e., water, soil and environmental buffering) are appreciated but often elicit a "not
183 in my backyard" response, which in the context to this study indicates not "at the expense of my livelihood". It has been
184 shown that, raising awareness about conservation to the local communities surrounding the forest through participatory
185 training and providing alternative way of livelihood reduces the threats to the forest [9, 10, 11]. When the local
186 communities are empowered in the sustainable utilization of the forest such as bee keeping, they are able to provide
187 support in the forest conservation [6, 15] argued that the provision of alternative protein and income-generating sources is
188 one of the best strategies at the community level to reduce wild meat consumption and trade while aiming to improve local
189 livelihoods.

190 4.2 Knowledge on improved bee keeping

191 Most people had no knowledge about improved beekeeping. Very few people were practicing traditional beekeeping
192 which is not environmentally friendly and less profitable. For example, they used methods that resulted in ecological
193 degradation (e.g., falling trees). Introduction of improved beekeeping as the alternative livelihood to local community
194 surrounding Magombera forest save as a means of ameliorating the environmental and livelihood problems. Alternatives
195 should always be locally relevant, and market analyses should be conducted for alternative income generating activities
196 [16], 21]. It's a good idea to choose livelihood activities that had have already been used to some extent in the project
197 region.

198 Encouragingly, most case-study projects had have chosen alternative livelihoods that were pre-existing in communities,
199 this increase increasing the likelihood of uptake and success of the project. A good example of the importance of
200 choosing locally-relevant activities was provided by the relative success of the DABAC (Developpement d'Alternatives au
201 Braconnage en Afrique Centrale) project in Cameroon, and the other cane-rat rearing projects in West Africa [17, 22].
202 The reason that why it worked very well in Cameroon, is because they are already livestock rearers. They know already
203 about chickens and rabbits, and in this respect the cane rat is just a small modification on something that already exists.
204 In comparison, cane rat rearing was unsuccessful in other Central African countries where participants did not have a
205 history of livestock rearing. Gabon wasn't a very favorable environment for (cane rat farming), in the sense that the
206 Gabonese are not naturally livestock rearers, and even less rearers of wildlife. So already, it is not an obvious
207 autonomous economic activity for the Gabonese. The same applies to Magombera village community members; they had
208 the knowledge of traditional bee keeping before the introduction of the improved bee keeping. This facilitated the success
209 of this project in their village.

210 4.3 Habitat destruction and Tree planting

Comment [A19]: Of course – if you are attempting to cut these traditional natural resource users from accessing the forest and its diversity of resources- you will alienate them towards conservation and clandestine harvests (poaching) of natural resources will make sustainable management impossible. Driven by poverty and desperation, they will mine the natural resources for short-term gain without the luxury to look to the future and the adverse impacts this might have for their children and grandchildren. I hope you get this and if this paper does not bring out and highlight such issues, it should not be published.

Comment [A20]: What alternative livelihoods other than bee keeping??? What about the saywers, charcoal makers, traditional medicine and thatch grass collectors, traditional hunters, fishers, etc. Are you helping them to manage the foest resources on a sustainable basis and empowering them to be the guardians of the forests instead of the enemies of the forest guards!!!!???

Comment [A21]: Once again you are talking preservation here. I have no problem with domestic protein sources, but don't you realize if the wildlife – as a source of protein and other forest products are not available to the people, then the forest will be seen as an impediment to their survival and as we see all over Africa, the forest will be turned into farm and grazing land. As people increase so will their domestic sources of protein (livestock) and they will out-compete the wildlife if it has lost it value to the local people as a cultural, economic and nutritional resource. I fear you are talking PRESERVATION & FAILED INTEGRATED RURAL DEVELOPMENT – SOLVING ALL THE PROBLEMS ON THE FARM, WHILE LECTURING THE LOCALS TO LEAVE THE FOREST ALONE. What Western NGO do you represent??? You throw the word CONSERVATION around, but everything you imply is PRESERVATION. Is on-the-farm BEE KEEPING – an alternative to sustainably using all the other forest resources. You are kidding yourselves!!!!

Comment [A22]: Once again spell out the full name of the project. Maybe you should read what is said in this article: [Financial & economic values bushmeat in rural & urban livelihoods in Cameroon](https://www.cifor.org/publications/pdf_files/articles/ALescuyer1601.pdf) Int. Forestry Review 2016 https://www.cifor.org/publications/pdf_files/articles/ALescuyer1601.pdf

I have no problem with farming wild rodents for bushmeat. Also see: [Potential of rodents for minilivestock in Africa](https://www.researchgate.net/publication/266372129_Potential_of_rodents_for_minilivestock_in_Africa) CIRAD 2004 https://www.researchgate.net/publication/266372129_Potential_of_rodents_for_minilivestock_in_Africa but this doesn't stop the need to sustainably manage wild animals used by the community as a source of protein!!

The book I recommended that I co-authored with Professor Reilly, goes into some detail the failure of CITES to deal with bushmeat and the need to sustainably manage this resource!

211 The habitat degradation observed ~~to affect~~ in the Magombera forest ~~is largely~~. ~~Much of this destruction is~~ attributed to
212 anthropogenic activities such as tree cuts and farm extension. It is self-evident that populations and species will suffer
213 when their habitat becomes degraded or is lost completely [18,19, 20]. In this context, the destroyed habitats need to be
214 restored to rescue the species with time. To make the initiative meaningful and successful, the involvement of local
215 community members ~~is very important. This makes people to have the gives them a sense of forest ownership to the~~
216 ~~forest and the project.~~ In this project, involvement of local **communities in tree planting of trees was found to result in**
217 **positive attitudinal changes of the participants towards forest conservation-be good.** However, some plant species did not
218 grow well. This could be due to biotic and abiotic factors. Seedling establishment can be limited by several factors. High
219 seed predation and low germination rates in some species, competition with pasture grasses, stressful microclimatic
220 conditions, lack of soil nutrients, reduced mycorrhizal inoculum, and herbivory affect seedlings establishment [21] A
221 number of other studies have also demonstrated that some native species show growth rates in disturbed areas similar to
222 those of more commonly used exotic species [20]; this might also be the same case to the well grown species in this
223 project.

224 4. CONCLUSION

225 Conservation education and sensitization on the importance of biodiversity should be provided to the communities living
226 **adjacent** to the protected **area** so that they can participate positively in protecting and conserving the area. Involvement of
227 public (Community-based biodiversity conservation approach) in managing the protected area could be the best option
228 because people will have the sense of ownership to the protected areas and be ready to protect biodiversity and provide
229 information concerning poachers and other threats which may destroy biodiversity. This can only happen if people are
230 aware and involved. Additionally, alternative ways of livelihood relevant to a particular community should be taught to the
231 community so as to reduce their dependence on the forest for their livelihood.

236 COMPETING INTERESTS

237 The authors declare that they have no competing interests

241 CONSENT (WHERE EVER APPLICABLE)

242 Not applicable.

244 ETHICAL APPROVAL (WHERE EVER APPLICABLE)

245 Not applicable.

Comment [A23]: Is this to be an off-limits protected area (good luck) or a conservation area made available to the community based upon management plans for the different resources developed in collaboration with the traditional natural resource users from the community???? This is unclear. You are just getting started, and you must bring out the next phase of this project, after tree planting and bee keeping on the farm - sustainable harvest of the forests natural resources in collaboration with the community. If not, this paper is just another Integrated Rural Development Project destined for failure - making out like it is conservation, but really preservation of the forest from the people that will turn many into poachers and result in further degradation of the forest and its resources - another Western Biased & likely funded Project!!!!!!

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