Final Evaluation Report

Your Details	
Full Name	Sarah Adiel Mero
Project Title	Assessment of *Artemisia annua* to control invasive *Gutenbegia cordifolia* at Mwiba Wildlife Ranch in Great Serengeti Ecosystem
Application ID	29707-1
Grant Amount	£6000
Email Address	meros@nm-aist.ac.tz
Date of this Report	16th February 2022

1. Indicate the level of achievement of the project's original objectives and include any relevant comments on factors affecting this.

Objective	Not achieved	Partially achieved	Fully achieved	Comments
Objective 1: To examine *A. annua* crude extract efficacy in suppressing the germination and growth characteristics of *Gutenbegia cordifolia*				This was fully achieved using experiments in the laboratory and screen house, where in the laboratory we tested the efficiency of crude *Artemisia annua* in different concentrations (0, 50 and 75%) on seeds of *Gutenbegia cordifolia* and observe germination percentage, mean time and mean germination rates. In the screen house we again tested the efficiency of the different concentration treatment of crude *A. annua* on young *G. cordifolia* seedlings and observed its effects on biomass (dry and fresh), height and chlorophyll content as growth parameters. Hence in both experiments we noticed higher concentration treatments of crude *A. annua* gave best results in suppressing germination and growth characteristics of *G. cordifolia*.
Objective 2: To compare efficacy of a natural herbicide (*A. annua*) over that of a chemical herbicide (glyphosate) in suppressing *G. cordifolia*				This objective was achieved by comparing efficacy of a natural herbicide (*Artemisia annua* crude extract) over that of a synthetic chemical, glyphosate, Roundup 360 and used the most efficient concentration of *A. annua* (75%) and for glyphosate used the recommended dose as per manufacturer. The findings were interesting and promising since we found that crude *A. annua* was almost as effective as the chemical herbicide (glyphosate) in suppressing growth parameters particularly on dry biomass and height of *G. cordifolia*
Objective 3: To determine effects of fire on germination of *G. cordifolia* seeds				This was also fully completed however using another alternative methodology due to some un-predicted circumstances found in the field. We used a heat-shock test experiment using

				time (1 and 5 minutes) and temperature (20, 60, 90,120,150 and 200° C) factors to predict the effect of heat or fire on *G. cordifolia* germination survival. Hence the results showed that higher temperatures (150 -200 ° C) could be used to suppress seed banks but moderate temperatures (60 -90°C) showed to propagate germination and speed up establishment of *G. cordifolia*
Objective 4: To evaluate effects of shade on germination and growth characteristics of *G. cordifolia*				We fully achieved this experiment in shade houses that we created to mimic forest conditions in the field with different shade intensities. We used shade nets of 50% and 80% shade levels and a control to see the effects of each shade treatment on *G. cordifolia's* germination and growth characteristics. Our findings showed *G. cordifolia* favouring medium shade (50%) and unshaded (0%) environment as harvested plant individuals were healthier and taller compared to those grown under high shade (80%), indicating that this species establish better in disturbed habitats like patches with big forest gaps.

2. Please explain any unforeseen difficulties that arose during the project and how these were tackled.

- COVID-19 pandemic was the major unforeseen drawback for our project as it limited most of the experiments which were planned to be done in the field (in-situ). This forced us to change some methodologies and conduct experiments ex-situ (in the laboratory and screen house) considering we resumed in the college later after six months isolation period.
- The institute's bureaucracy in obtaining funds was another major unforeseen difficulty in acquiring funds to start the project activities. This issue caused a delay to start activities as planned on the timeline schedule.
- Fire or burning events in the field done by neighbouring villages due to poaching as well caused a difficulty to conduct field experiments.

3. Briefly describe the three most important outcomes of your project.

- A scientific paper on environmental factors (fire and shade) and non-chemical methods (crude *Artemisia annua*) to control *Gutenbegia cordifolia*. This is not yet published but currently received a minor revision for possible publication in the Journal for Nature Conservation.

- Outreach to communities living around Mwiba Wildlife Ranch, where we had an opportunity to educate and emphasise the conservation of native species to achieve a sustainable living environment. We visited a primary school and a secondary school to educate youths and met with village representatives at the Makao centre to educate the villagers on importance of conserving native species as well as encouraged on limiting the use of synthetic chemicals in natural fields to prevent pollution in the soil and water, but rather opt for traditional or natural alternatives.

- Stakeholder gathering with Mwiba Holdings staff, Friedkin conservation staff and the Mwiba Lodge staff, were we showcased a presentation on our project achievements, way forward and challenges encountered. This meeting involved a Q&A session where we answered about issues of conservation and community perception particularly on invasive species and how to look upon the possibility of integrating each method for effective control of invasive species.

4. What do you consider to be the most significant achievement of this work?

5. Briefly describe the involvement of local communities and how they have benefitted from the project.

This project involved the locals by giving education on importance of conserving native species so as to continue benefiting from them, e.g., food security, fresh air and forest products like fruits. Also, we provide the schools we visited with some learning materials i.e., writing pens and chalk for teachers. We as well provided t-shirts, brochures and postures to villagers to emphasis and encourage conservation.

6. Are there any plans to continue this work?

Yes, since most experiments were conducted ex-situ given the unforeseen circumstances and the results were based on ex-situ, we hope to be repeated same experiments in-situ i.e., in natural field conditions to see whether what we observed in the laboratory and screen house explained the same in natural setting.

Moreover, we wish to conduct more conservation awareness rising outreach programmes to study the perception of local communities on invasive species since in our last session we realised that *Gutenbegia cordifolia* is used for traditional purposes such as medicine and therefore changing their perception to kill the plant did not seem to please them. Hence a major drawback in conservation since the locals perceive the plant as a medicinal species and not an invasive. This therefore calls for more awareness rising programmes to change the local mind set.

7. How do you plan to share the results of your work with others?

Our results have been shared in seminars, meetings, and workshops at different conservation gatherings. Nevertheless, we plan to publish our work (in progress) and continue doing presentations of our achievements in meetings, conferences and other conservation gatherings whenever given an opportunity.

8. Timescale: Over what period was the grant used? How does this compare to the anticipated or actual length of the project?

The grant was our major financial supporter for the year 2020-2021, from June 2020-November 2021 which is almost an 18 months instead of the planned 11. Given the unforeseen circumstances i.e., COVID-19 outbreak, and delay to acquire funds from the institution, most activities were postponed and pushed further which led to delay the project commencement in June instead of February 2020. Hence a change of timescale and delay to submit this report on time.

9. Budget: Provide a breakdown of budgeted versus actual expenditure and the reasons for any differences. All figures should be in £ sterling, indicating the local exchange rate used. It is important that you retain the management accounts and all paid invoices relating to the project for at least 2 years as these may be required for inspection at our discretion.

Item	Budgeted Amount	Actual Amount	Difference	Comments
Journal publication costs (2)	1748		-1748	Since the fund granted was the main source of finance, we reallocated this amount to other activities since we added other important activities as requested by the Rufford Review Board during proposal submission. So alternatively, we asked to publish as subscription (no payment) instead of open access which was way over the suggested budget.
Thesis binding costs	100	120	+20	Due to rising costs of binding materials we had to reallocate from the suggested budget some amount to achieve the desired quality
Thesis printing costs	279	600	+321	Was required to submit 4 copies each costing £150
Hand towels	20		-20	
Gloves	6	6		Same amount
Marker pens	1	1		Same amount was used
Pencils	2	1		Same amount was used
Workshop/ community outreach (two-way	300	1500	+1200	The reallocated budget for journal publication was used for

travel to Makao-Mwiba area, travelling to reach communities costed 800£, accommodation cost 480£and food expenditure 220£				conducting the outreach program which was very important in this project.
Field assistants (3) @200£	450	600	+150	Budgeted less than the actual amount we used to pay for assistance
Camera	244	250	+6	Budgeted less than the actual amount spent
Laptop	350	350		Same amount
Meter ruler	1	1		Same amount
Scissors	1	1		Same amount was used
Liquid soap for washing hands	10	25	+15	Purchased more due to covid outbreak; we were extremely cautious and required to wash hands daily, after each activity to prevent risks of infections
Spade	8	8		Same amount
Data sheet printing costs	34			
Notebooks	6	6		Same amount was used
Ropes	3			
Boots	41			
Plot making tape x 4	20			
Paper bags for sample drying	5	5		same amount used
Supervisor travelling costs	104	240	+136	Added some costs due to fuel prices and vehicle hiring costs
Travelling for data collection	104	240	+136	Added some costs due to fuel prices and vehicle hiring costs
Soil sample bag	25		-25	This amount was used for other expenditures since we did not do soil analysis
Lab coat	17	17		Same amount used
Pots for experiment	122	100	-22	We budgeted more than the actual amount
First aid kit	45	45		Purchased less the budgeted amount
Petri dishes	104	95	-29	We budgeted more than the actual amount
Whatman Parker	34	48	+14	Added some amount to due to increased price
Screen house	349	349		Used same amount

Microwave extraction (MAE)	349		-349	Since we changed the methodology, this amount was reallocated for other activities and expenditures throughout the project
GPS device	244	235	-9	The actual amount was less than the budgeted amount
HPLC Analysis	874		-874	Since we changed the methodology, this amount was reallocated for other activities and expenditures
Sub-total	**6000**	**4843**	**-1157**	
Pens		30	+30	We reallocated some amount since we had to buy more pens to give out to students visited in the schools
Outreach posters with conservation notes		100	+100	Originally this was not included in the budget, but we reallocated some money that was not used in purchasing other items which we did not use as per change in methodology.
T-shirts and logo prints		240	+240	Also was not included originally but was added for giving out to local communities, and stake holders during outreach and stake holder meetings
Brochures printing costs		70	+70	Also was not included originally but was added for giving out to local communities, and stake holders during outreach and stake holder meetings
Stakeholder meeting venue costs		200	+200	Originally, we did not include it but used the amount available to pay for the venue at Mwiba Headquarters
Shade nets		250	+250	Was not included in the budget, but was purchased for the shade net experiment
Distilled water(5litres)		5	+5	Was not included originally, but was purchased for laboratory experiments
Dimethyl sulphur dioxide (DIMSO) (2 litres)		200	+200	This was purchased for the chlorophyll determination experiment
Marking tape (I roll)		2	+2	Purchased for labelling apparatus in the lab and screen house
Ethanol (I litre)		60	+60	Purchased for disinfecting lab

				apparatus to prevent fungi infections which could interfere with results.
Misc. costs		117	+117	
Total	**6000**	**6117**	**+117**	**The additional amount £117 was used for extra expenditures or unpredicted costs throughout the project**

10. Looking ahead, what do you feel are the important next steps?

Our current study results are based in the laboratory and screen house setting (ex-situ) given the mentioned unavoidable circumstances. Way forward is to conduct the experiments in natural setting as the original plan. Also, we hope to continue awareness rising outreach programs to local communities around Mwiba Wildlife Ranch so as to change their perception on invasive species which they consider to be traditional medicine like the *Gutenbegia cordifolia*, which hinders conservation efforts.

11. Did you use The Rufford Foundation logo in any materials produced in relation to this project? Did the Foundation receive any publicity during the course of your work?

Yes, we used the Rufford Foundation logo on printed t-shirts, posters, brochures and presentations. We went public through social media platforms like Facebook and Instagram stories to reach out a larger group of people and encourage more projects to seek grants from The Rufford Foundation.

12. Please provide a full list of all the members of your team and briefly what was their role in the project.

Prof. Anna Treydte: The project main supervisor; monitored the progress of each stage of the research.

Dr. Issakwisa Ngondya: Mentor; co-supervised the whole project.

Mark Ghaui: Project coordinator from Friedkin Conservation Fund and Mwiba Holdings; checked all field activities and co-supervised the whole project.

Prof. Minnick Tamera: Assisted in designing the methodology for data collection.

Ms Margret Casein: Research assistant during reconnaissance survey and data recording

Mr. Sylvester Temba: Research assistant in the laboratory

Mr. Kessy Slaa: Research assistant in the screen house

Ms Sarah Adiel Mero: Project leader, main researcher, statistician, proposal writer, manuscript author, main presenter in outreaches and stakeholder showcasing.

13. Any other comments?

On behalf of my team, I would like to give our sincere gratitude to The Rufford Foundation for funding this project and making it possible to accomplish my master's degree as a requirement to graduate. This has opened up opportunities in my conservation career and helped to continue my PhD studies in the near coming future due to the research experiences gained during this study. With such experience, we promise to continue being conservation ambassadors and motivators to young researchers who wish to expand their career with an assistance of Rufford Small Grants from The Rufford Foundation. Thank you and God bless.