

## Final Evaluation Report

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Your Details	
Full Name	Warda Kanagwa
Project Title	Biological Control and Socio-economic impacts of the invasive <i>Parthenium hysterophorus</i> in Arusha, Tanzania
Application ID	27383-1
Grant Amount	£4,844
Email Address	<a href="mailto:kanagwaw@nm-aist.ac.tz">kanagwaw@nm-aist.ac.tz</a>
Date of this Report	21 <sup>st</sup> February 2020

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
To assess the effectiveness of <i>Zygogramma bicolorata</i> in controlling <i>P. hysterophorus</i>				<p>Our experiment revealed that Biocontrol agent (<i>Z. bicolorata</i>) is effective in controlling <i>P. hysterophorus</i> particularly when they are released at highest population. They are capable of reducing <i>P. hysterophorus</i> vegetative growth (number of leaves, flowers, seedbank and biomass).</p> <p>And we recommend that beetles should be introduced at densities of at least five male and female beetles per meter square for highly efficient and wide range coverage.</p>
To evaluate the effectiveness of <i>C. auriculata</i> and <i>D. caffra</i> in suppressing <i>P. hysterophorus</i> growth in comparison with 2,4-D.				<p>We tested a novel approach using naturalized extracts of <i>Dovyalis caffra</i> and <i>Cassia auriculata</i>, two readily available and often cultivated plants in Tanzania, and compared their effectiveness in suppressing <i>P. hysterophorus</i> with the chemical 2,4-D Dimethylamine (2,4-D)</p> <p>We suggest that the use of environmentally friendly bio-herbicides can foster <i>P. hysterophorus</i> control and emphasize that this method should be integrated with current control measures in the infestation areas for long-term suppression of the invasive</p>
To assess and document the socio-economic impacts of <i>P. hysterophorus</i> invasion on livelihoods of farmers and pastoralists in Arusha				<p>We interviewed 123 farmers and 128 pastoralists in northern Tanzania. Farmers mentioned that the invasive reduced crop yield and negatively affected their income. Formation of lesions and reduced milk quality and quantity were named as consequences for livestock.</p> <p>We conducted outreach program and capacity building in the areas where interviews were done. In</p>

				<p>each ward 50 people were trained on how to control Parthenium, basic biology and ecology of the weed so as they can recognize as the seedling and remove them.</p> <p>We agreed in the coming village general meeting trained people to educate others on how to control this menace.</p>
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**2. Please explain any unforeseen difficulties that arose during the project and how these were tackled.**

- Rain was a major setback during evaluation of the effectiveness of *C. auriculata* and *D. caffra* in suppressing *P. hysterophorus* growth in comparison with 2,4-D. we had to prepare other extracts since the first experiment was ruined by rains.
- During data collection in some village, people did not understand Swahili, so local translators were hired.
- Also, rainfall caused the researcher to postpone some of the activities and conduct them in the later months, example during *Z. bicolorata* assessment in the field areas where it was introduced.
- During interview some of the areas were had to get at, so we hired a motorcycle for a wide range coverage.

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

- In this project we managed to raise awareness not only to farmers and pastoralist in Arusha Tanzania, but also through forums, meetings, workshops, school visits and distribution of brochures and fliers to local communities trained. We have trained about 300 farmers and pastoralists at Muriyeti, Sepeko, Olasiti and Mbuguni wards of Arusha Tanzania. They were trained on the use of biological control, herbicidal extract and basic biology and ecology of the weed so as they can identify them as a seedling and remove them. Below are some of the pictures of the trained household members.







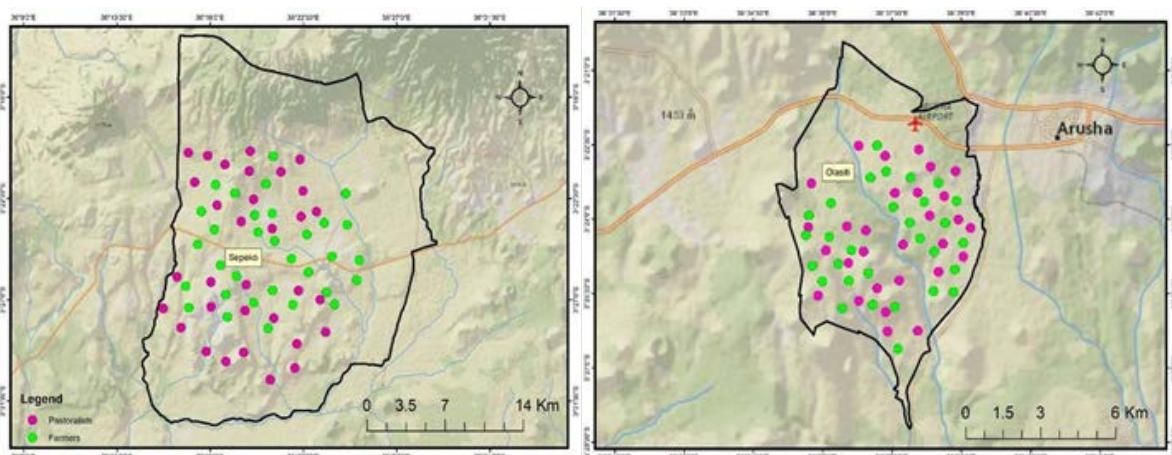
Figure 1: Some of the household members who were trained on the effects and management of Invasive *Parthenium hysterophorus* in Arusha Tanzania.

- We managed also to present our findings during Arusha Conservation Agriculture Forum at the World Vegetable Centre on Monday 13<sup>th</sup> January 2020 were more than one hundred participants participated in the forum. See the pictures below.



Figure 2: Result dissemination during Arusha Conservation Agriculture Forum at the World Vegetable Centre.

- We also produced a map below which shows the study area and distribution of household who were interviewed.



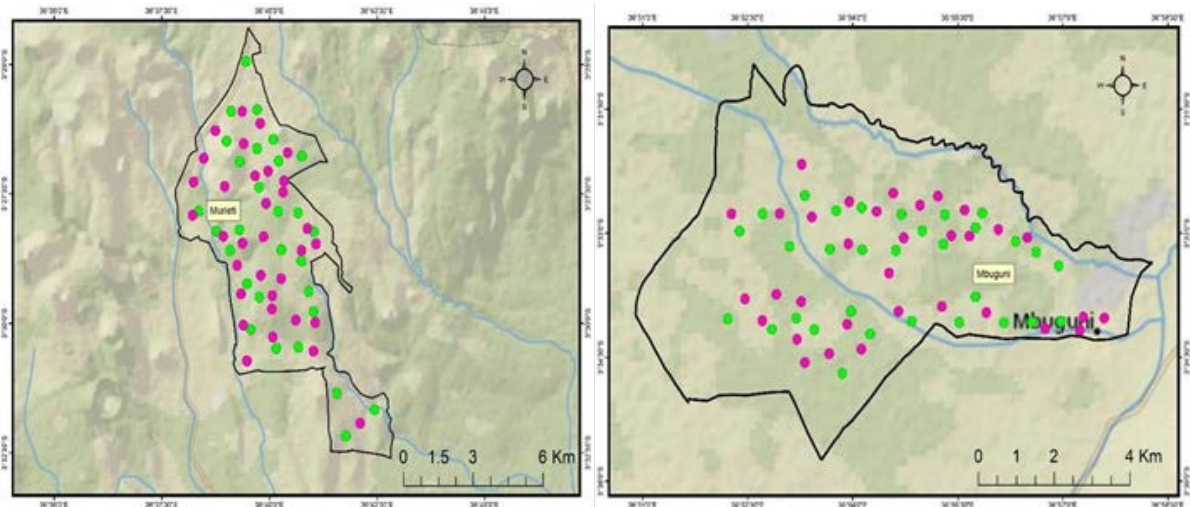


Figure 3: Map which shows interviewed household distribution at Murieti, Olasiti, Sepeko and Mbuguni.

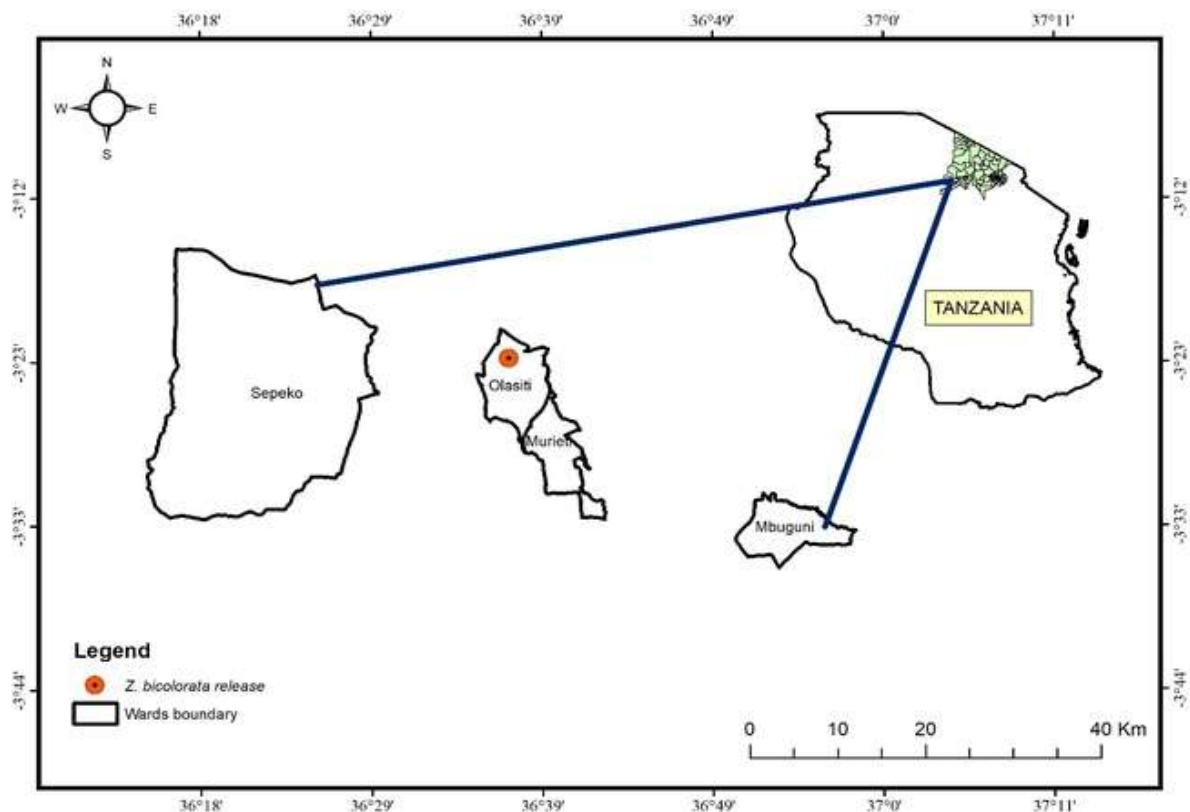


Figure 4: Map of the study area

- The project also found that local communities are not aware on the impacts of the weed and biological control of *P. hysterophorus*. See the results below

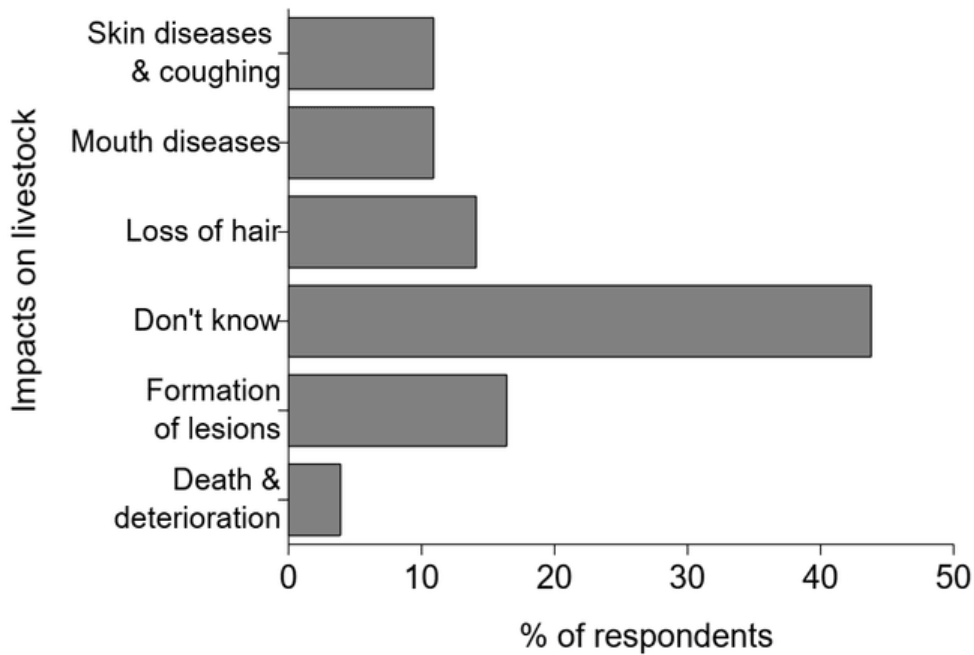


Figure 5: Impacts of *P. hysterophorus* on livestock.

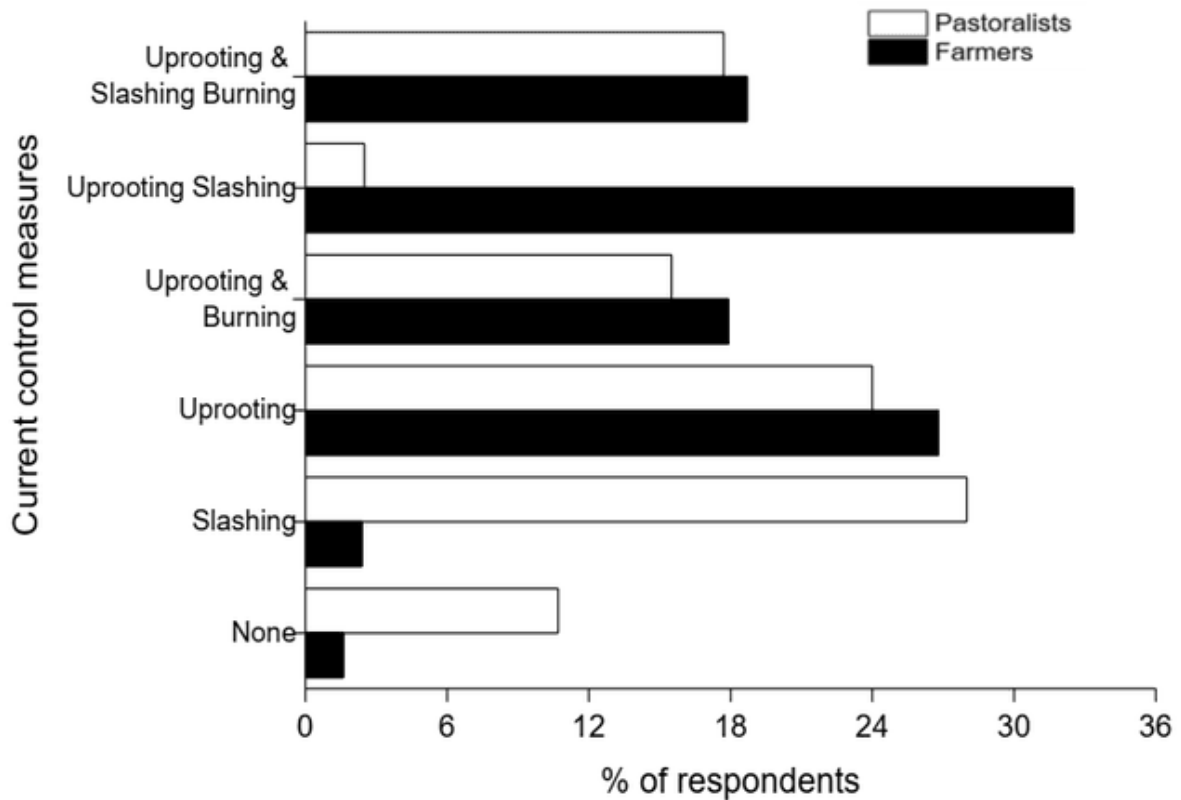
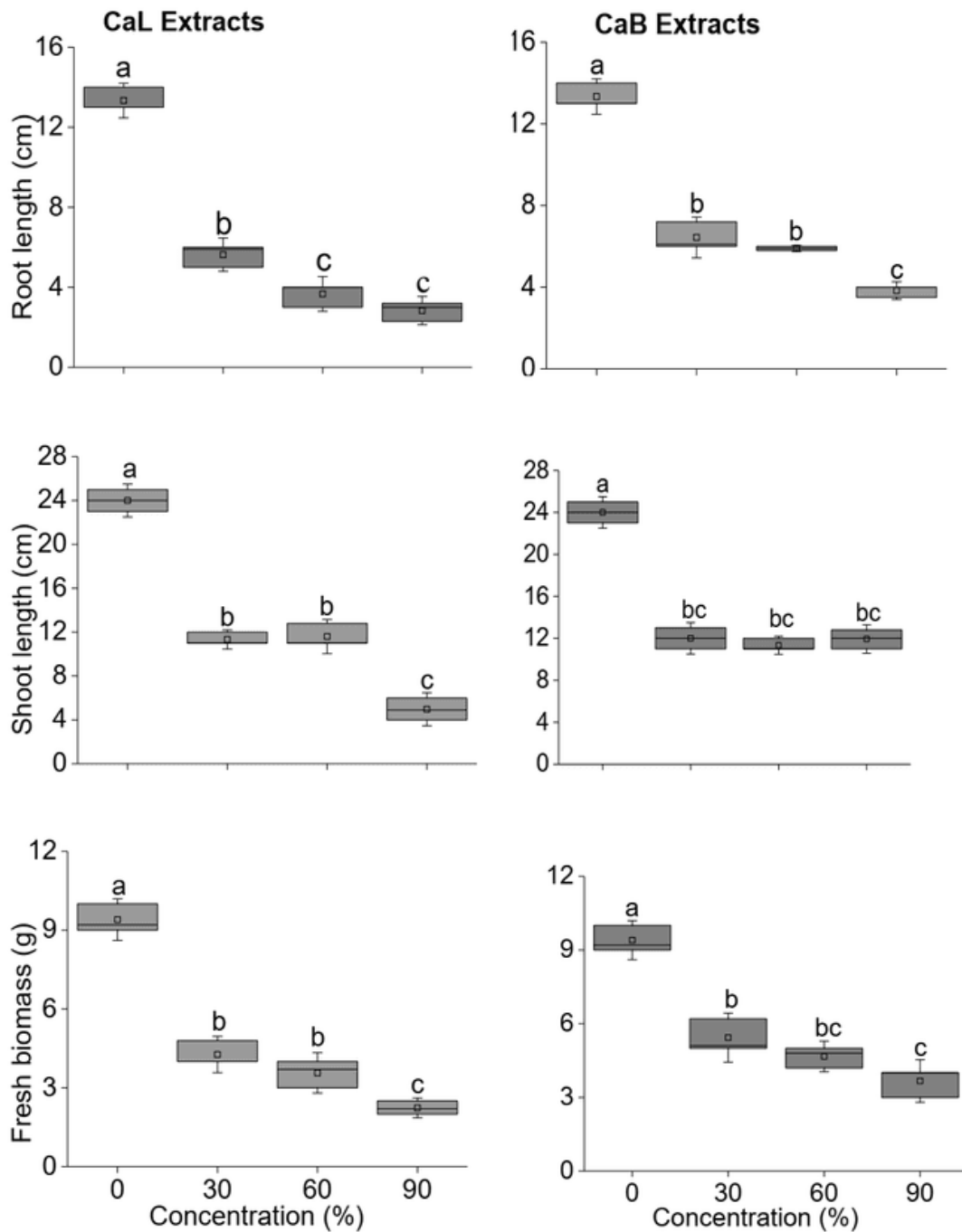


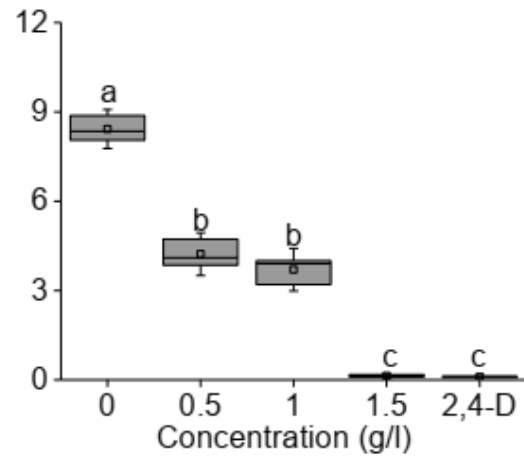
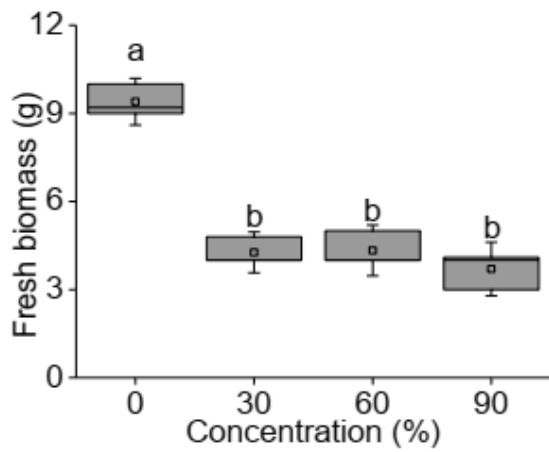
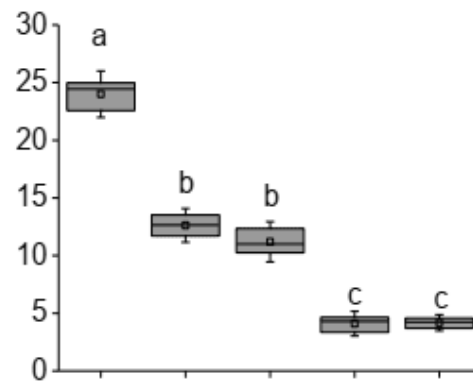
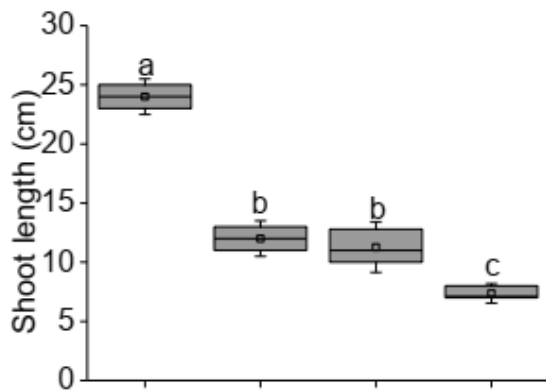
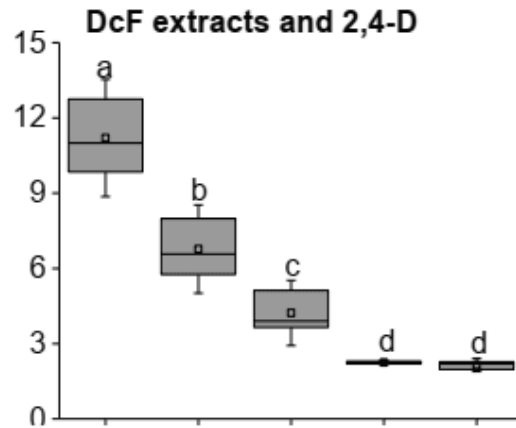
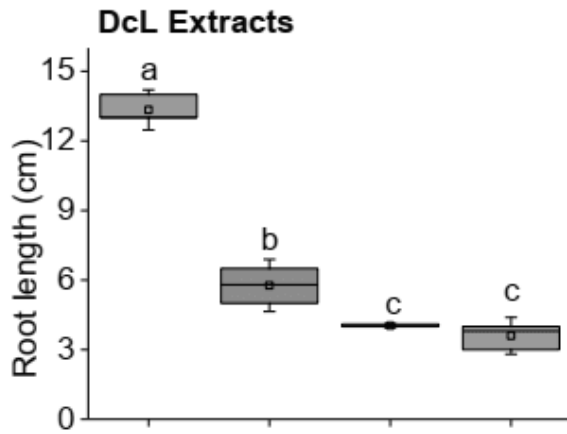
Figure 6: Farmers and pastoralist current control measures.

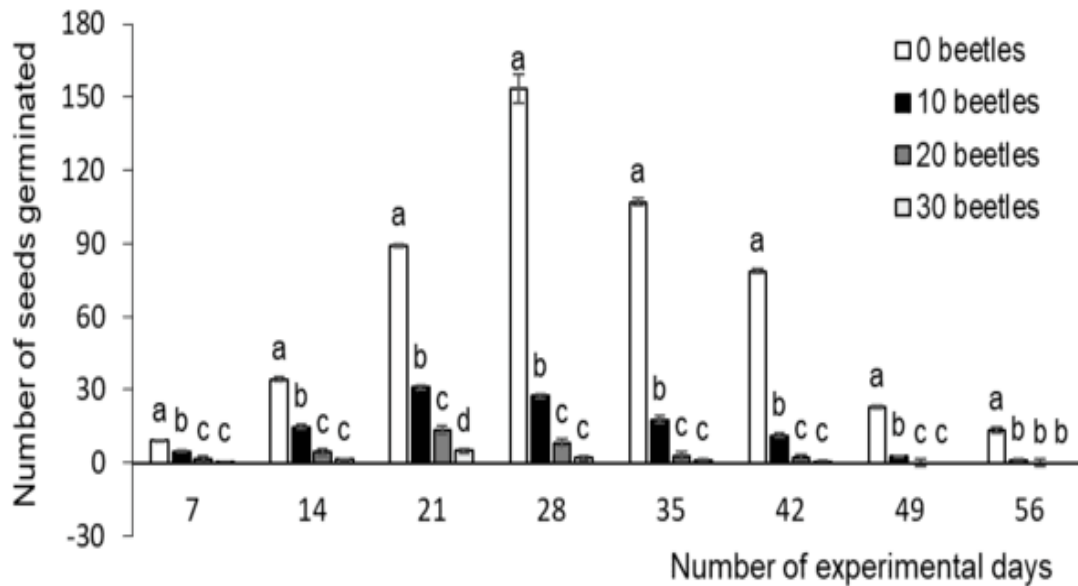
- This project managed to come up with a novel approach of using herbicidal extracts of *C. auriculata* and *D. caffra* rather than a chemical herbicide 2,4-D dimethylamine. We found the extract of *Cassia auriculata* leaves and barks and *D.*

caffra leaves and fruits are capable of reducing *P. hysterophorus* root length, shoot length, Fresh and dry biomass, and also chlorophyll content and seedbank. See the figures below.

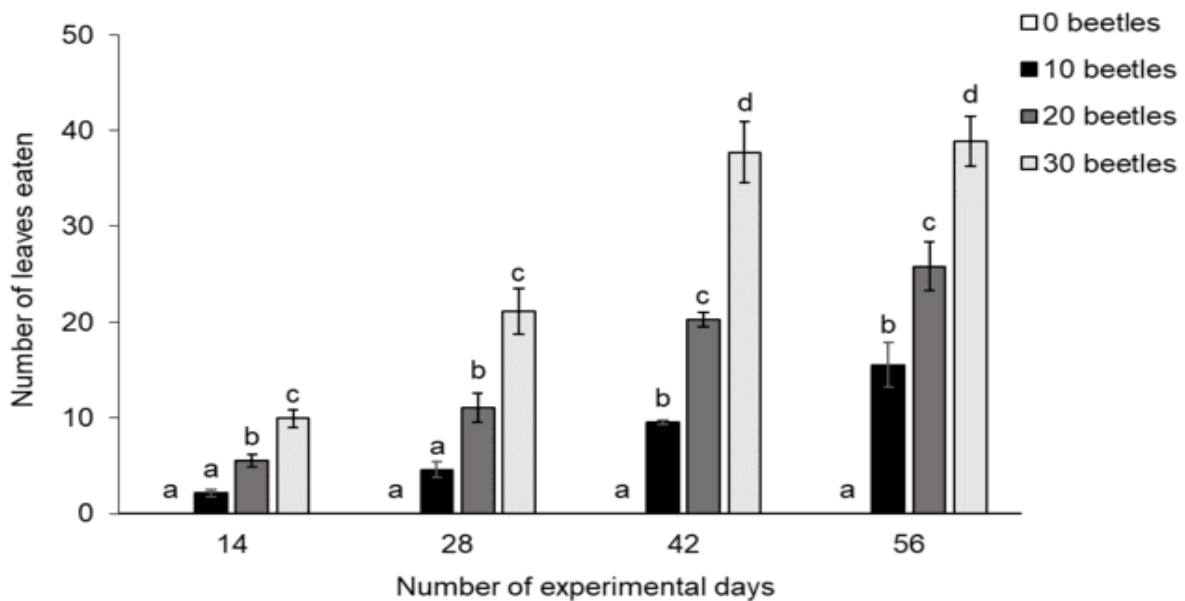








Furthermore, we found that Beetles particularly at densities of at least five male and female individuals per meter square for high effectiveness.



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

Local communities were trained on impacts and management of *P. hysterophorus*. We conducted outreach programme and capacity building to household members. We interviewed 251 farmers and pastoralist and educated them as well. Brochures and fliers with information about the weeds were distributed to local communities and ward executive officers.

## 5. Are there any plans to continue this work?

Yes, since *P. hysterophorus* is spreading at alarming rate in Tanzania, Kagera, Mara, and Geita regions there are a need for local communities to understand on how this species can be controlled/managed. We are expecting to conduct outreach program and capacity building in the aforementioned regions. Areas which are highly invaded, and which are not invaded will be selected and local communities will be educated on the impacts and possible control measures of this menace. Furthermore, we are expecting to characterize the herbicidal extract used at molecular level to identify which are bioactive compounds present and responsible in suppressing *P. hysterophorus*. In addition, more studies will be done to explore naturalized plant species that can also perform the suppressive effects to *P. hysterophorus*. Lastly, we are expecting to conduct proper field studies that verify whether the beetles really do not feed on other plant in the wild once *P. hysterophorus* is depleted. This will confirm the safe use of the beetle when released in the wild

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

The results have been shared through workshops, seminars, forums and meetings. We have managed to come up with two manuscripts titled

1. "*Effectiveness of Zygogramma bicolorata as a biocontrol agent against Parthenium hysterophorus in Arusha, Tanzania*" it was submitted in Biocontrol science and Technology journal (Taylor and Francis) – status- submitted reviewer's comments.
2. "*Socio-economic impacts and management practices of the invasive plant Parthenium hysterophorus in Arusha, Tanzania*" it was submitted in Human Ecology (Springer) – status- under review.

We are preparing a final report on the status of this weed and we will share with responsible districts councils (Arusha urban, Monduli and Arumeru).

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

The project was conducted for eleven months instead of the planned six months. This was delayed because of beetle's experiment. We had to change a little in the methodology and conduct an experiment for six months, addition of seedbank for three months. In addition, we had to do outreach programme and capacity building for at least 300 local communities. Due to that there was a change in the timetable due to availability of people.

8. **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.

I requested £ 4,844, I received USD 6050.83 which is Equivalent to £ 4631.30. See the attached receipt which I shared also with Jane Raymond after receiving it.

Item	Budgeted amount	Actual amount	Difference	Comments
Pots for experiment (50 pots @£1.66)	83		-83	I purchased this using personal fund
Whatman Packet (2 sets @ £ 16.66)	33		-33	I purchased this using personal fund
Lab coat (2 @ £ 33.33)	67		-67	I purchased this using personal fund
T-shirt with Rufford logo (20 @£6.66)	133		-133	I did not print the T-shirts
Poster printing (10 posters @£11.66)	117		-117	I purchased this using personal fund
TAWIRI conference (1 @ £ 200)	200		-200	I did not attend TAWIRI conference instead I attended ACAF forum and paid using person fund
Flyers printing (100 @£ 0.66)	66	200	+134	Used to purchase flyers for results dissemination
Outreach programme (5 meetings @ £200)	1000	1100	+100	Used for hiring projector and venues, purchasing flip charts, flip chart stand, mark pens, notebooks, drinking water during the workshop
Publication cost to peer reviewed journal (1 @£ 200)	200		-200	Planning to use personal fund
Field assistants (4 months' work) (2 persons @£100/ month per person (i.e. 2 x £100 x 4 months)	800	800		Paid for field assistant
Stationaries (printing data sheets, pencils, notebooks 50 etc.) (Various stationaries (approx. cost £50)	50	130	+80	Used to purchase stationaries



Supervisor travelling cost to TPRI (4 times @ £16.66)	67		-67	Used their cars to TPRI
Reconnaissance cost (3 days@ £13.33)	40		-40	I used personal fund
Travelling cost for interviews (30 days@£8.33)	250	260	+10	Used to pay for transport during data collection for me and assistants
Travelling cost to TPRI from NM-AIST (120 days @£ 5)	600	300	-300	Used to travel to TPRI
Screen house (1 @£ 333.33)	333	333		Paid for screen house
Plots Preparation (12 @£ 6.66)	80		-80	I used personal fund
Watering equipment (Set) (2@ £16.66)	33		-33	I used personal fund
Soil Characterization (25@£ 8.33)	208		-208	I used personal fund
Soil sample bags (1 @ £16.66)	17		-17	I used personal fund
Petri dishes (50@ £ 2.33)	117	200	+83	Used to purchase petri dishes
First aid kit (1@ £16.66)	17		-17	I did not purchase this
2 casual labour		193	193	Paid for casual labour for ploughing, weeding, and nursery establishment
Brochures		243	243	Paid for brochures
Motorcycle hire		182	+182	Used during data collection due to inaccessibility to some areas
Travelling costs for results dissemination		240	+240	Used to pay for transport cost during results dissemination for me and my assistants
Fuel		100	+100	Paid to transport to where <i>Z. bicolorata</i> were release
Camera (Canon) (1 @ £333.33)	333	350	+17	Used to purchase a camera
<b>Total</b>	<b>4844</b>	<b>4631</b>	<b>-213</b>	

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

Important next step is to conduct outreach programme and capacity building or other regions which are highly infested with *P. hysterothorus*. Additionally, we are expecting to characterize *Cassia auriculata* and *Dovyalis caffra* at molecular level so as to come up with active compound associated with suppression of *P. hysterothorus*.

**10. 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, in every presentation made, fliers and brochures distributed Rufford logo was used to increase publicity and grant acknowledgment. Also, in the manuscript submitted Rufford conservation grant has been acknowledged.

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

**Prof Anna C. Treydte:** Associate professor: Biodiversity Conservation and Ecosystem Management, School of Life Science and Bioengineering, Nelson-Mandela African Institution of Science and Technology, Arusha, Tanzania. In this project her task was support and supervision of entire activity, data analysis and commented on manuscripts.

**Prof. Minnick Tamera:** Restoration ecologist: Environmental & Physics Sciences: Colorado Mesa University. She provided support on data analysis and commented on the manuscript.

**Dr. John Bukombe:** Principal researcher: Tanzania Wildlife Research Institute: He supervised the work and advised on experimental layout.

**Mr. Ramadhan Kilawe:** Centre Coordinator: Plant Protection Division: he supervised the experiment at Tropical Pesticide Research Institute.

**Ms Dainess Samwely and Marry Macha:** they helped in irrigation, nursery establishment, ploughing and data collection.

**Ms Catherine Elias:** a graduate of B.Sc. Wildlife Management at Sokoine University of Agriculture. She assisted on questionnaire data collection, data entry and results dissemination.

**Anna Kimario:** a graduate of B.Sc. Geography and Environmental studies from the university of Dar-es-salaam. She assisted on questionnaire data collection, data entry and results dissemination.

**Ms: Warda Kanagwa:** studying M.Sc. Biodiversity Conservation and Ecosystem management at the Nelson Mandela African Institution of Science and Technology. She was a project leader who conducts all the data collection, data analysis, first drafts of manuscript, report writing and results dissemination through outreach programme and capacity building.

**12. Any other comments?**

This project would never have been accomplished without the blessing and power of Almighty God, and generous support and kind assistance of many dedicated individuals and not all of whom can be mentioned. I offer my profound gratitude to all. Am extremely grateful to the financial support from Rufford Small Grants for

Nature Conservation for funding this project. We are gratefully for the intense work done by the reviewers and not to forget our dearest Jane Raymond you're the best thanks you abundantly.