A Socio-cultural Analysis for the Characterization of Problematic Plants in Tanzania

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Research Abstract

This study focuses on gender and age differences for the characterization of problematic plant species in Northern Tanzania using local and non-western knowledge framework. The objectives of this study were to 1. Identify key differences among gender and age groups based on the characterization of problematic plant species and 2. Determine key species and characterize traits related the Maasai livelihoods and socio-cultural dynamics.

Ecological disturbances such as land use land cover changes, altered nitrogen and carbon cycles, and climate change can influence the increase problematic plant species and impact the livelihoods of these communities including pastoral livestock husbandry, cultivation, well-being, and ecosystem of this region. Problematic plants might include species that are hazardous to livestock or recognized for taking over cultivated fields. The characterization of these problematic plants and age and gender group dynamics are largely not understood.

Cultural, social, and economic factors can influence the transmission of Traditional Ecological Knowledge (TEK), where there is variation in the ways in which people recognize and utilize plant resources. Data for this project was provided by a pilot study concentrated on characterizing the problematic plant species and identifying those traits using participation and collaboration from focus groups that includes individual ranking and scoring for those plants. Our results indicate that female participants identified *Almererwaki* plant species to be most problematic, while male participants identified *Alairahirah* as most problematic. In terms of age, both young and old male participants found *Alairahirah* to be most problematic, while the younger female participants identified *Sangari* as most problematic plant, and older female participants found *Almererwaki*. Future results could lead to more effective natural resource management practices through the classification of these problematic species and understanding of community dynamics, improving pastoral livelihoods, and enhancing diversity and inclusion in research.

1. Introduction

1.1 TEK and Maasai socio-ecological systems

The focus of this research project takes place in Northern Tanzania, specifically the Simanjiro district, and is largely occupied by the Maasai peoples. This region is characterized as a semiarid and arid dryland, and receives a relatively low level of precipitation, about 100-1000 mm per year. The temporal and spatial distribution of precipitation varies stochastically, which can be further worsened by extreme climate events (Ellis & Galvin, 1994). Climate patterns and events such as drought, wildfire, and flooding create the potential for problematic plants to increase in frequency and severity. There is a concern for the agro-pastoral practices that which sustain the livelihoods of the Maasai communities by the common use of herding livestock and the growth of plant species in small and home gardens. The Maasai people exhibit adaptive management practice and resilience such as through monitoring and adjusting their land use patterns, livestock herding strategies, and conservation practices to adapt to challenges related to climate variability, habitat loss, and wildlife conflicts. Their resilience is structured in their unique identity and Traditional Ecological Knowledge (TEK), defined by values, ethics, culture, and identity to land related to natural resource management practices. TEK refers to local or indigenous peoples knowledge system and production and concerns to information about the environment (Whyte, 2013). TEK sustains the socio-ecological systems of this region and is not fully recognized in the scientific communities.

1.2 Socio-cultural dynamics of the Maasai communities

Cultural, social, and economic factors (gender and age) are among the central factors for the transmission and possession of TEK. Gender and age organization can be associated with division of labor, and structural and relational power in communities, and thus can influence the ways in which individuals utilize and perceive plant resources (Da Costa et al., 2021).

Gender in the Maasai land is based on structural and relational power and is largely dependent on the male's age group. The male member and age group system is a basis of a complex network, traditionally found with concern of the governance of resources. Women responsibilities then depend on multiple factors, which include marital status, relationship, and age of male. Depending on these factors, women are seen to occupy labor positions in forest extraction, house-construction, child-care, and household responsibilities. Polygyny is also prevalent, where male household leads have multiple females to split occupational activities. Land use changes have been linked to livelihood shift and diversification in these regions, where pastoralist communities are seen to rely more on women in livestock handling and resource governance and men are migrating to cities for work. (Westervelt MO., 2018). The age group of female members in Maasai communities are largely based on the male age group, depending on the marital status and relationship with that male. Ages are based on classes or cohorts rather than numbers, and are approximate, and this was maintained for the purpose of the report.

2. Research Questions and Hypotheses

This project explores the difference in participant response for the characterization of problematic plant species. We anticipate there to be differences among the groups when completing the indices, where participants are likely to mention traits and rank species higher that correspond to their social, cultural, and or economic position in the community. For reference, male individuals might identify species if they pertain to livestock handing, where women instead might identify species related to children or human well-being. Age cohorts might have less variance in their response, due to the age groups overlap in the division of labor, given that younger groups largely accompany parents of their gender to assist with labor. With this, consideration and questions were formed:

- How will age and gender groups differ in the rank and scoring for problematic plant species?
- How do these differences reflect the socio-cultural dynamics of the Maasai communities?

Other considerations and questions that were formed for this report inquire variation in the participant response among the sorted groups from the severity measurements in the study, thus attempting to answer the following question: "Is there variation from the participant ranking and scoring for the problematic plant species?" These questions directly relate to the applied qualitative socio-ecological methods and inquire about whether the original method in the project for determining the characteristics of the species was adequately designed for individual and sample group exploration of gender and age groups.

3. Appendix 1

3.1 Methods Outline

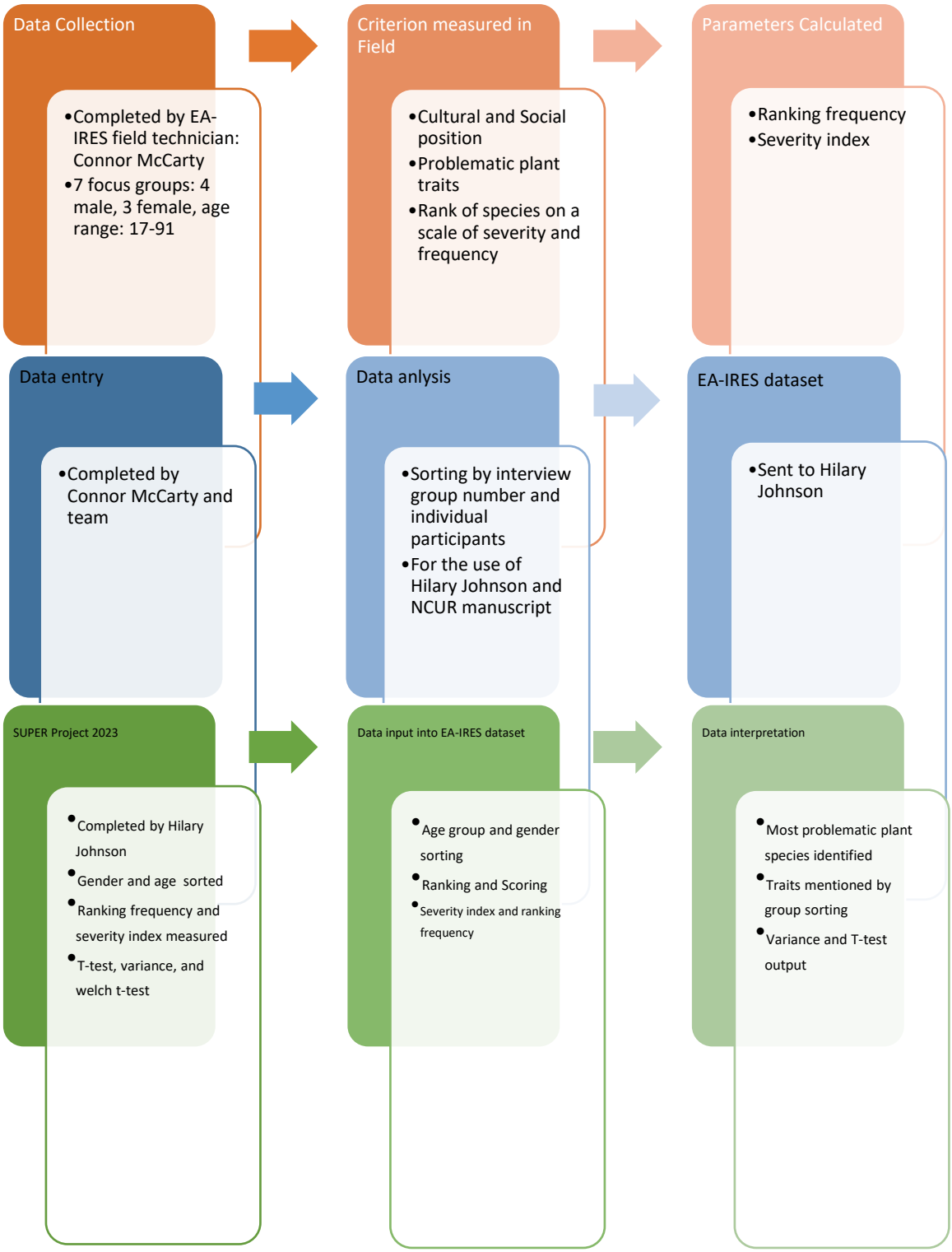

Figure 2. Data collection, entry, analysis, and methodology for data analysis implemented to complete the research project and answer questions.

Methodology

3.2 Data Collection

For 5 weeks, seven focus groups were conducted in the Northern part of Tanzania, using participants within the Sukuro and Kitiengare villages of the Simanjiro district. There were 60 total participants from the focus groups and were separated into 4 groups of males and 3 groups of females and with a total of 34 male and 26 female participants. These groups were separated to encourage inclusive discussions and involved junior adults to senior elders to respect the collective wisdom. We identified the largest age of the individuals being 91 and the youngest being 17 years old. The age groups are described as from young, junior, junior elder, to senior eldest groups that range from 19-91 but are approximate: *Niongulo*, *Korianga*, *Landis*, and *Makaa*. The youngest being *Niongulo* and the eldest senior being Makaa. The approximate age groups were sorted between less than 50 and over 50 years of age. For example, the *Korianga* age group is less than 50, but ages can reach up to 49. Age groups were sorted into 4 categories, that combined the *Niongulo* and *Korianga* group as one group: young, and the Landis and Makaa group: older. Older male (OM), young male (YM), older female (OF), and young female (YF) were used for the purpose of the research project. There was a total of 12 OM, 22 YM, 10 OF, 16YF individuals in the designated groups.

Participants were first asked questions about their demography, concentrated on their age set and orientation. Participants were then asked to identify problematic plant species. *Majani*, or grass and forb plant species were the primary plant species identified for the purpose of this study. The participants were then asked to rank the identified problematic plant species individually using a participatory ranking method where each person was provided 2 sets of 3 colored stickers with labels for identification. Red corresponded with 1, yellow as 2, and blue as 3. The participants were to rank the species on their own degree, and were to rank the species with Red as their 1st and top or most problematic, and so on.
The three plants with the highest scores were then identified further to describe problematic traits and related ecological patterns using the discussion groups and interviews. Traits and characteristics of these plants were then identified in each group using an open pool for discussion. These interviews were translated from Swahili Maa language to English using direct translation during the focus groups by a native translator for researchers.

a). Pictures of Maasai female group participants b) Focus groups were held outside under large tree

3.3 Focus group questions

3.31 Personal information

*1. What is your age? (*exact)*

2. What age set are you/your husband a part of?

3. Do you have livestock, a shamba, or both?

4. For how many years have you or your family grown crops?

3.32 Identify problematic plant SPECIES

5. Which species of majani (grasses and forbs) in this area do you find to be problematic for you, your animals, your shamba, the environment, or anything else?

6. What problematic traits does this species exhibit?

7. What species of miti (woody plants) do you find to be problematic for you, your animals, your shamba, the environment, or anything else?

8. What problematic traits does this species exhibit?

3.33 Ranking exercise

9. Place this sticker next to the species that is most problematic for you.

10. Place this sticker next to the species that is second most problematic for you.

11. Place this sticker next to the species that is third most problematic for you.

3.34 species-specific question (ONLY for top three species of each functional group) 12. What effects does this plant have on your animals?

13. What effects does this plant have on cultivation?

14. What effects does this plant have on water availability?

15. Do problems with this plant occur in the wet season, the dry season, or both?

16. How does this plant respond to flood?

17. How does this plant respond to drought?

18. You've told me this plant affects livestock (in this way) . How do your livestock affect this plant?

19. You've told me this plant affects shambas (in this way) . How does cultivation affect this plant?

20. Is there a place near here that you find this plant in large quantities? 21. Is it common or uncommon in highlands?

22. Is it common or uncommon in pastures?

23. Is it common or uncommon in shambas (cultivated fields)?

24. Is it common or uncommon in korongos (river channels)?

25. Is it common or uncommon in engusero (wetlands)?

26. Do you remember this plant from your childhood?

27. When did you first see this plant in the region?

28. Has this plant increased, decreased, or stayed the same over time? Why do you think that is?

29. What benefits does this plant provide to your or your community? Does this plant have any uses?

These questions were directly extracted from the pilot study as part of the East African International Research Experience for Students (EA-IRES) facilitated by Connor McCarty and team (MCcarty, 2018)**.**

4. Data analysis

A salience and severity index were identified using the ranks and scores from the participatory ranking methods. Severity refers to how problematic the plants were ranked on the scale of 1-3, using an inverted scoring system; number 1 colored stickers were given a score of 3, while 3 was given a score as 1, and 2 was given a score as 2. So, if the participant ranked that plant as their number 1, the score of 3 would be multiplied to that ranking for the scoring of that plant. These numbers were then added for the inverted problematic score using the three scores of the inverted values. The mean individual problematic score was then calculated by dividing the inverted problematic score by the total number of ranks the plant received in each group. The ranking frequency for the severity index is calculated by dividing the number of ranks the plant received by the total number of participants in each group (M, F and OM, YM, OF, YF). The salience index refers to how prevalent that species was mentioned and was calculated by dividing the number of times a plant was recorded, by the total number of focus groups, and is otherwise not used for the purpose of this research report. The interview descriptions for the plant qualities and mentioned traits from participants were grouped using translational code, similarities, and confounding variables that related to the redefinition of problematic traits and the category of problem, e.g., invasive. Four important variables were used for reference, which include those related to livestock, agriculture, humans, and environment.

A welch two-sample t-test was tested for the group severity measurements, to compare the differences between the means of the four age groups to the amount of variation within each group, assuming unequal variance. We used R software, a programming language for statistical computing, to perform the welch t-test for the groups. We first created the dataset, which took the severity measurements from each group, and then coded this to perform a t-test for each group, and includes defining the vectors (F, M and OM, OF, YF), nesting an inner and outer loop, computing that t-test, and storing those results and related combinations in the data frame.

5. Results

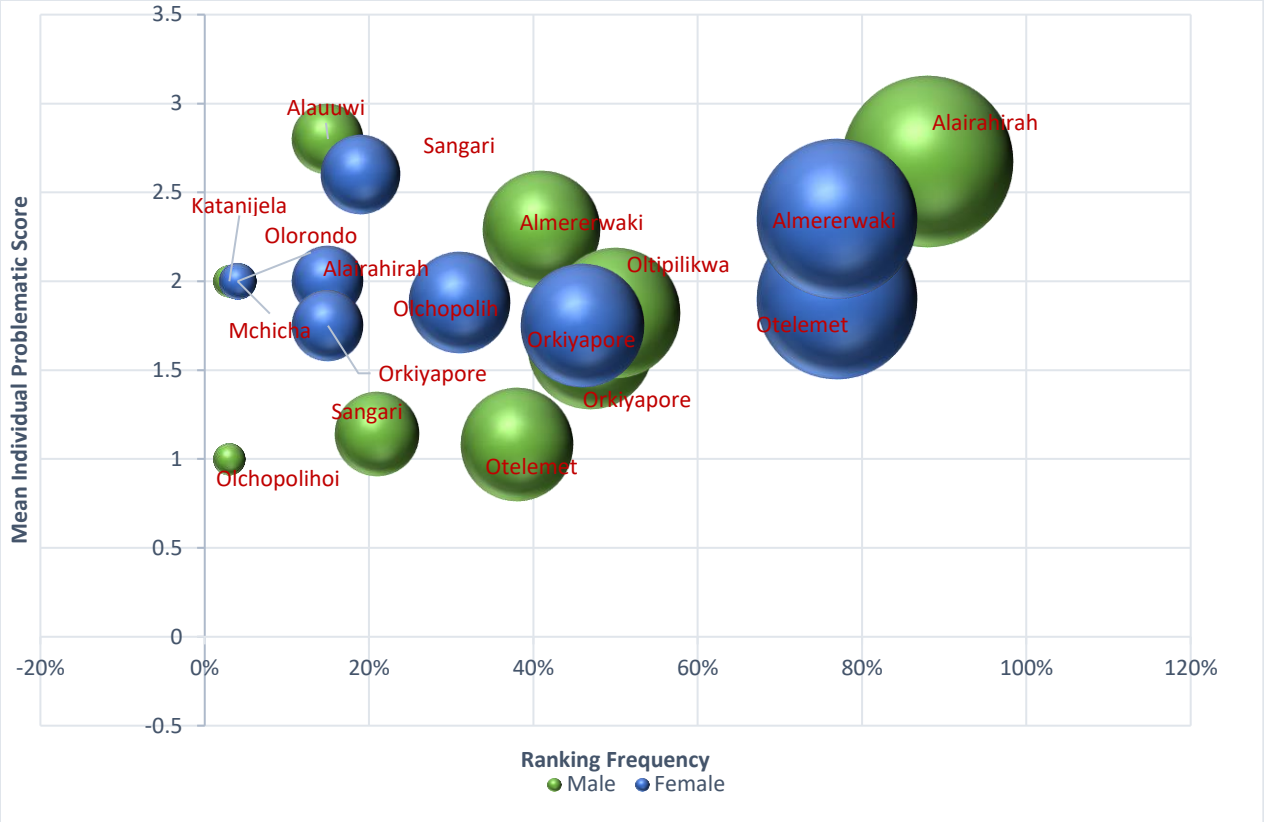

Figure 2. Severity measurements for the plants that have salience scores higher than zero within the male and female groups, adjusted for the difference in group sizes.

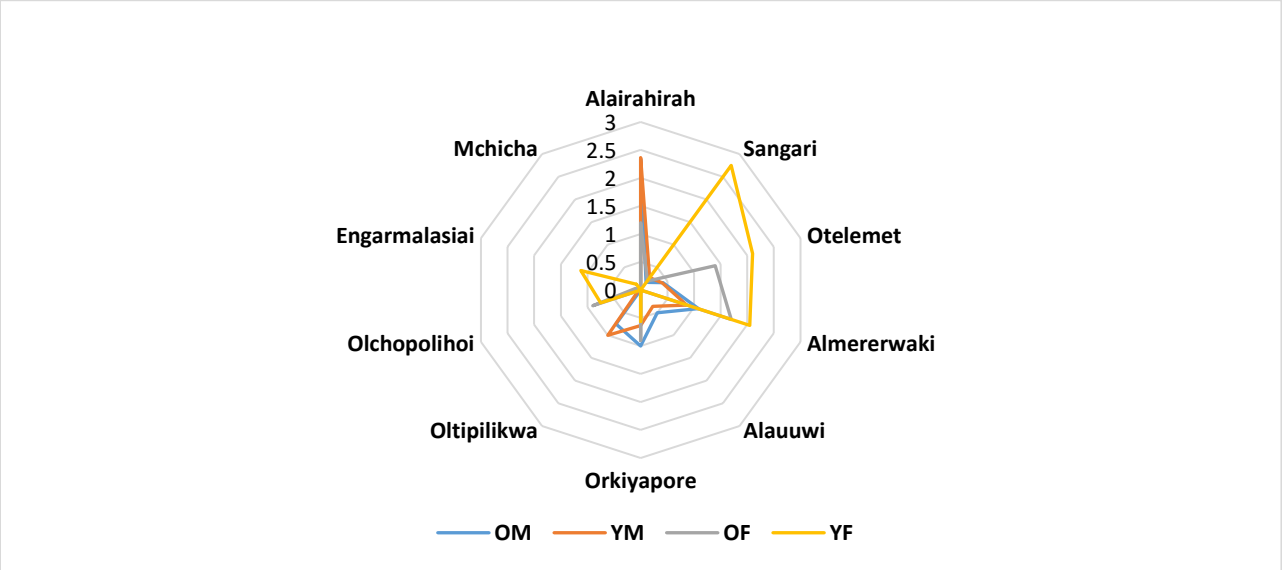

Figure 3. The severity index measured for plant species that received a salience score greater than zero, separated into the four age and gender groups, adjusted for the difference in group sizes.

5.1 Description of Problematic plant using Maasai descriptors.

5.11 Alairahirah – rattlepod (crotalaria)

Alairahirah, or rattlepod (crotalaria) is a genus of flowering plants that belongs to the Fabaceae family. A known trait is its ability to produce toxic alkaloids and is associated to the Maasai descriptors of the plant, which include being noxious to livestock and observed to give cows and livestock illnesses, and if ingested, can stop milk production for a female cow, weakness, and even death. Both young and old male participants identified this to be most problematic.

5.12 Almererwaki

Almererwaki is similarly ranked highly as a problematic plant. This plant has been seen to cause livestock death, soil drainage problems, and competitive for water nutrients, which kill nearby vegetation. The plant also has thorns and can be a nuisance to both humans and livestock. The scientific name has not yet been identified, and future research is required. The older female participants identified this plant to be most problematic.

5.14 Sangari

This species has not yet been identified scientifically and was also not described in detail during the focus groups, due to its original ranking as less severe, where only the top few species were described in detail. More research is required to identify specific species traits. The younger females identified this plant to be most problematic.

Figure 4. Coding of problematic traits for the female focus groups. The size indicates the number of times the code was mentioned by participants during the focus group discussions.


Noxious to humans
Adult death, 1
Skin irritant, 1
Thorns painful for...
Child death, 6
Noxious to livestock
Livestock death, 7
Open wounds, 4
Milk loss, 4
Extended hooves, 4
Weakness, 3
Painful for livestock, 2
Chest sickness, 2
Sterility, 1
Joint pain, 1
Blindness, 1
Advantageous in agricultural systems
Crop death, 9
Water extraction, 6
Cultivation impairment, 4
Nutrient loss, 2
Extensive root system, 2
Advantageous in natural systems
Pasture loss, 6
Disappearance of grasses, 3
Rapid expansion, 2
Widespread...

Figure 5. Coding of problematic traits for the male focus groups. The size indicates the number of times the code was mentioned by participants during the focus group discussions.

Figure 2. shows the ranking frequency and mean individual problematic scores from male and female groups multiplied to represent the severity index for each problematic plant. The results found that the female groups identified the most problematic plant to be *Almerwaki*, while the male groups identified *Alairahirah (Figure 2)*. Larger sizes for the circles in the graphic indicate the plant severity level, from low, moderate, to higher severity. For example, *Alauuwi* and *Sangari* plants were ranked have a large mean problematic score, but a relatively low-ranking frequency, or low salience score, so it does not have a high severity index score and is positioned in the moderate level. The OM and YM group found the *Alairahirah* plant to be most problematic, while the OF group found *Almererwaki*, and the YF group found *Sangari* based on the severity index (Figure 3).

Coding for problematic traits presents findings for the mentioning and responses for coding for the problematic trait and found the code for noxious to livestock was greater among the male groups (Figure 5). Instead, the female groups indicated advantageous in agricultural systems code as their most problematic trait, and indicated the male groups also had a greater number of responses compared to the female groups for the noxious to human responses, which includes child death as a common coded response (Figure 4).

The welch t-test results showed that there was no significant difference in the severity index measurement s between male and females, p-value= 0.9514. The gender and age groups welch test similarly found no st atistical significance in the groups:

p-value welch t-test results	*Old female*	*Young female*	*Old male*	*Young male*
Old female	1	0.50	0.97	0.90
Young female	0.50	1	0.49	0.45
Old male	0.97	0.49	1	0.94
Young male	0.90	0.45	0.94	1

Table 1. The results of the Welch T-test for the age and gender groups using the severity index measurem ents

6. Discussion

The results of the indices, trait characterization from the participant response indicate a great competency of plant species, categorization of species and traits, and overall socio-ecological knowledge. There were clear differences in these responses and discussions among the studied groups. The male groups recognized the *Alairahirah* plant species to be most problematic, in both the young and old groups, and this species is regarded as a livestock noxious plant, which might suggest support for the research hypothesis that these species correspond to their age and gender role, where men are largely livestock handlers compared to women. The female groups identified *Sangari* (YF) and *Almererwaki (OF).* The *Almererwaki* plant species also relates to livestock handling, human well-being, and agricultural systems, where *Sangari* is not yet recognized. More information is needed to further suggest a strong correlation between age, gender, and division of labor on the classification and severity measurements for these problematic plants but is otherwise notable for this research report.

The welch t-test results indicate that the young female and young male participants has the lowest p-value (0.45). Instead, the old male and old female has the highest p-value (0.97) and yet these results were not statistically significant. This might be due to the influence of age, and more research is required to understand its importance. Our findings advise future studies to focus on data collection and methods for

the purpose of a gender and age analysis within the characterization and identification of problematic plant species and traits. Future studies might include a larger sample and population size, equal population sizes among gender and age, and more information about the social-economic variables (age, income, education) between the gender groups to validate these differences, capable of impacting the responses notwithstanding gender variables. Limitations for this research include but are not limited to the methodology and data collection not fully or directly related to the purpose of this research. A future study might also test for heterogeneity, which refers to the differences or diversity within a population, that includes characteristics, opinions, or behaviors that correspond to the ways in which the participants respond in a participatory ranking exercise. Although this test was not included in the purpose of the report, it is strongly advised for further understanding of the participant responses and comparison among the gender and age groups.

7. Conclusions

The intention of this project was to inquire about gender and age differences and distribution for the identification and classification of plant-based issues and specific species. It must be noted that “invasive” is not a commonly used term when referring to problematic plants, and instead, “overthrowing” or “taking over” is used to describe plants that control and compete for resources for plant ecosystem dynamics within TEK. This is due to the community ecological understanding that plants are not invasive.
There were several differences in the response that are prominent, in which male, female, and age groups identified different species and traits that correspond to a non-western framework for plant identification. The results suggest there to be eminent differences among these groups, where the species and traits mentioned might reflect the division of labor, socio-economic, and cultural dynamics within the community. The other intention of this project was to engage in community collaboration and involvement of Traditional ecological knowledge for a greater competency of ecological problems. The next step for this project is to further explore this research question where a future study might ask questions related to socio-economic and culture dynamics as well as test the qualitative data and responses for heterogeneity. It should be mentioned again that this research project extracted information and data from a previous pilot study, and that the data and methods of the previous study were not directly related to the purpose of this study and is reflected in the results.

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