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Compiled and edited by Julie Snorek



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Evaluating the EcoFutures Pilot Program

By Elisabeth Sanson, Meghna Ray, Leeya Kekona, Lindsey Reitingner

BACKGROUND

The Alfred Nzo District suffers from high levels of youth unemployment, a lack of access to tertiary education, and a host of environmental issues including water scarcity and energy challenges. In this district, 53% of youth are unemployed and 96% of the population lacks access to tertiary education. Invasive species and unsustainable grazing patterns have dramatically degraded the landscape. Despite this, most community members are unaware of the importance of individual sustainable living habits and environmental preservation. EcoFutures is an ambitious pilot program that aims to address these challenges. School leavers” and matriculated youth are provided access to further education. This will help them gain the skills necessary to find employment and by facilitating local entrepreneurship in the green economy, EcoFutures hopes to create more jobs. Ultimately, the program seeks to generate widespread behavioral change and local empowerment by encouraging participants to spread their augmented environmental knowledge.

EcoFutures is facilitated by the uMzimvubu Catchment Partnership (UCPP), a collective of local NGOs and civil and state institutions seeking to protect the uMzimvubu river system and promote economic development of the area. Environmental Rural Solutions (ERS) and Conservation South Africa (CSA), two NGOs in the UCPP, work closely to facilitate the program. ERS received a grant to pilot EcoFutures from the WWF Nedbank Green Trust until mid 2019, and CSA received funding for the project from Citi Foundation. Tsoanelo Shata and Amos Siphumelele directly implement the program on behalf of these organizations with the support of other UCPP partners.

The program has three phases: Phase 1 selects candidates and provides informational workshops; Phase 2 gives selected candidates three months of hands-on experience by matching participants with sustainable businesses in their area of interest; Phase 3 matches participants with a year-long training and mentoring opportunity sponsored by a UCPP partner.



EcoFutures Selection Process and Filtering of Candidates

In Phase 1, EcoFutures provides free skills trainings to create employable youth and environmental stewards. Trainings are directed towards enhancing skills necessary for sustainable business creation including teaching youth about financial literacy, basic computer skills, and generating business ideas. In addition, trainings focus on evincing entrepreneurship opportunities in the green economy such as eco-processing, eco-energy, bioprospecting,

ecoranging, and ecotourism. To emphasize the necessity of living, consuming, and producing sustainably environmental topics such as natural resource management, constitutional and environmental rights, and water health are also taught.

In Phase 2, participants are matched with local businesses in their chosen sector of the green economy to provide exposure and experience. The pilot project is currently midway through this phase with 14 participants working with sustainable businesses including UMAfrika Recycling, Wild Coast Sun, and ECPTA. EcoFutures has helped participants develop new business ideas as well as cultivated the existing entrepreneurial aspirations through its classes. Businesses created by the participants include selling chickens, cabbage, and products created from the clearing of invasive plant species such as charcoal. In Phase 2, participants have the opportunity to submit business proposals to a panel for feedback and potential financial or logistical support. The proposed plan for phase 3 is a year-long training and mentoring opportunity for 4-8 EcoFutures candidates with UCPP mentors.

GOALS

Our goals were to assess the tangible impacts of the pilot program, identify its challenges, and offer preliminary recommendations for future iterations. We also sought to clarify the pilot's goals and scope, and understand how different UCPP partners viewed the program and their involvement with it.

Specifically, we investigated whether:

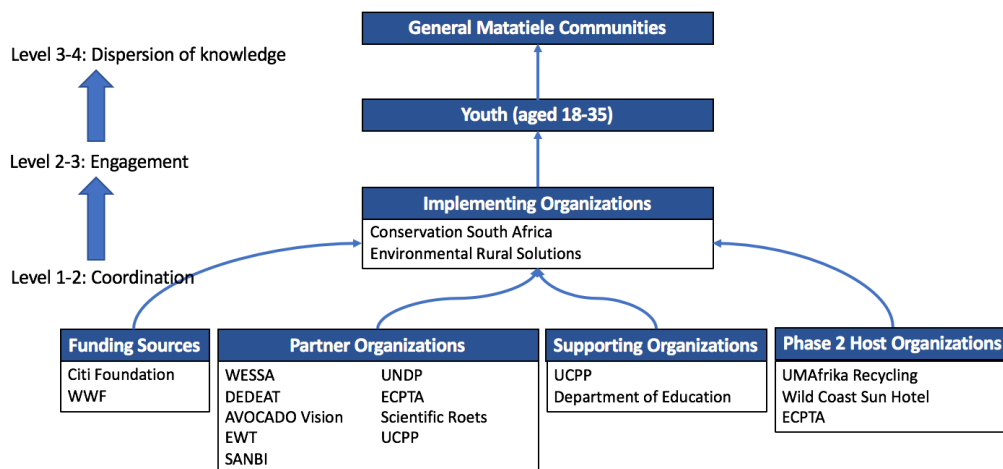
- Outreach efforts reached the program's intended audience
- Potential and current participants perceived the trainings to be beneficial
- The program influenced participant perceptions of the environment
- Youth were empowered to believe they can start their own businesses

METHODS, STAKEHOLDERS AND ACTIVITIES

Methods

- Interviews with 26 youth (aged 18-35) in the town of Colana
- Interviews with 10 current EcoFutures participants (of 16 total)
- Interviews with 9 program partners
- Interviews and informal discussions with program implementers, Tsoanelo and Amos

Stakeholders



Summary of Activities

We spent the first day of our time in Matatiele learning about EcoFutures from Tsoanelo and Amos, the two main program implementers. For our project, they asked us to evaluate the pilot, generate monitoring and evaluation tools to measure the program's efficacy, and create visuals to enhance awareness and outreach.

We created questionnaires targeting rural youth (Appendix i), program partners (Appendix ii), and current participants (Appendix iii), with feedback from Amos and Tsoanelo. The next day, we conducted individual interviews with out-of-school youth to understand their perceptions of the environment, employment challenges, and EcoFutures as a program. We interviewed participants in a large field behind the village chief's home. Several local interpreters assisted us with our interviews as most interviewees spoke little English.

We returned to Matatiele the following day to interview current participants and program partners. Ten of the sixteen participants were interviewed in the CSA office and most of the nine partner interviews were conducted via phone. Through our interviews thus far, we realized the potential of the project was constrained by limited funding and were inspired to create a promotional video to demonstrate the program's importance to funders.

To inform our evaluation of the program and begin filming, we interviewed key project implementers the following day. To see and film a functioning green business in action, we visited a participant's charcoal plant where he demonstrated how he cuts and burns wattle to produce charcoal. We then moved back to Colana to speak with more rural youth, generating a total of 26 interviews.

Over the next few days, we entered the data into an Excel spreadsheet for analysis and created various outputs to share with the UCPP. We quantified some answers from our interviews to identify any patterns or themes that could inform our feedback and supplemented our data with anecdotal evidence.

EVALUATION – Benefits, Areas of Improvement, and Data Limitations

I. Benefits of EcoFutures

Environmental Education

Of the participants we spoke to, 100% reported that EcoFutures made them more interested in the environment. Their responses also evidenced basic understanding of issues like

water shortage, spread of invasive alien species, and rangeland management. In comparison, the rural youth we spoke with in Colana had to be prompted with examples by an interpreter to think of environmental problems in their community. Many of them did not know about the negative impacts of wattle, and only one knew of the connection between wattle and water shortage. Additionally, they did not seem to value the environment as crucial to their lives, an observation that our conversations with Bongie supported. Participants also demonstrated understanding of the green economy and value chains, while rural youth seemed almost entirely unfamiliar with these concepts. Overall, EcoFutures appears to be meeting its goal of environmental education and awareness.

Personal Empowerment

The program also hopes to develop personal empowerment through building confidence, communication skills, and participants' senses of self-efficacy. While we did not specifically ask interviewees about their self-confidence and communication skills, participants were significantly more comfortable speaking with us than the rural youth. They also seemed more enthusiastic about creating businesses than our interviewees in Colana, and many reported having concrete plans to do so. Finally, all participants reported having strong role models, many of which were individuals from EcoFutures itself or otherwise involved in business.

Training Efficacy

Finally, we investigated if participants viewed the trainings as beneficial and relevant. While 100% of the people we spoke to reported that the trainings were indeed beneficial, we also received some anecdotal evidence that friends of theirs stopped attending trainings because they did not see their relevancy. One current participant informed us that she almost left EcoFutures after the first session because she did not see how it would directly benefit her, but stayed and later came to see the program's value. Training efficacy, therefore, is both an area of success and an opportunity for improvement. The courses were clearly beneficial to those participants still involved; however, this benefit may not be clearly communicated to all individuals in the beginning. Monitoring and evaluation tools, as are explained in the Potential Areas of Improvement section, will hopefully more concretely assess training efficacy.

II. Potential Areas of Improvement

As it is still in its early stages, the EcoFutures pilot offers important lessons and opportunities for improvement. We identified these areas of improvement as belonging to two categories: structural and logistical challenges, and overarching concerns.

Structural and Logistical Challenges

- Transportation
- Communication
- Monitoring individual and program status
- Funding constraints

Transportation

All but one participant we interviewed lived within 30 minutes by car of Matatiele. Half

identified transportation as an issue for either themselves or for friends that had applied to the program. Reported issues included the high cost of transportation and the limits to accessible transportation modes.

The barrier that transportation presents may lead to an unintended filtering of youth; only those who live closer to Matatiele and those who can more easily afford to pay for transportation can be involved. This places a heavy burden on an already vulnerable portion of the youth population, or renders them unable to participate. This portion includes youth without parents who could support them financially or who are unemployed. Limits to public transportation like the taxis or buses were also mentioned. One participant recounted that she could not attend many trainings because by the time the bus had come to her village it was full.

Presenting youth with a small barrier to participation – like transportation – can be beneficial in sifting through potential participants as it tests their level of commitment. In response to the aforementioned challenges, however, we suggest using a different metric of commitment to be more inclusive. Potential metrics include attendance, engagement with instructors, and/or the completion of required assignments.

However, some partners voiced concerns regarding participant abuse of stipends, and the program in general, as a method to obtain free lunches or other benefits. To alleviate concerns regarding stipend abuse, we propose the distribution of bus coupons to replace stipends or periodic distribution of smaller stipends that cover only the cost of bus tickets. Such bus coupons or stipends would be distributed at the previous training, therefore requiring continued attendance and ensuring proper use.

Communication

Communication between the program leaders and the participants was also identified as a challenge. This disconnect seems to be in both directions; many participants fail to effectively communicate with the program leaders about concerns or challenges they may face, and sometimes messages from program leaders fail to reach participants. One example of such an instance was when several participants reported not having known of a training they were supposed to have attended.

To address poor communication about attendance, we propose instituting a system in which the participant can notify the program leaders that they cannot attend a meeting (along with their justification) in order to receive notes on the training they missed. Such a system could encourage more participant communication while also giving feedback about the potential challenges they face in getting to trainings.

Additionally, in order to ensure clear communication from program leaders to participants, we propose diversified efforts including email, calls, social media, and applications like WhatsApp to ensure message reception. Emails and social media may not be enough, as many participants lack access to computers and WiFi. Therefore, by combining different methods of communication, the probability of the message being received by participants should increase. In addition, the next meeting date and time should be coordinated well in advance so that the information can be conferred to the participants at the end of the previous meeting. Each participant should also be asked about their preferred contact method, and reminders should be sent/made a day or two in advance.

Monitoring

Additional challenges may have come up for many participants, resulting in the loss of potentially devoted individuals. While there seemed to be a high rate of participants dropping from the program or missing trainings, we have no idea why this had happened. In addition to participant retention or no-shows, EcoFutures could benefit from receiving participant feedback on trainings. Some participants, for example, mentioned confusion about the content of some of the trainings.

In order to increase the opportunities for improvement, we created several monitoring and evaluation tools that could be used throughout the program. These include:

1. A post-training course questionnaire
2. A phase-completion questionnaire
3. An ongoing cohort study
4. Adding a few questions to the application

Post-training questionnaire

After each training course, each participant will be given a short questionnaire. The questions cover why the participant came to the training, feedback on overall training, whether they understood the material, and whether they plan to continue participating in EcoFutures, and if not, why. This questionnaire would help trainers to identify any hard-to-understand content, and flag participants who may be losing interest in the program.

Phase-completion questionnaire

After each phase, a slightly longer questionnaire could be given to participants. This questionnaire would give EcoFutures the opportunity to reflect on the bigger picture of the program and monitor whether EcoFutures is meeting its goals.

Ongoing cohort study

An ongoing cohort study that looks into participants professional life a year, five years, and ten years will help EcoFutures understand if the program has long-term benefits. A study like this could monitor if the businesses of former EcoFutures participants last, or fizzle out after a few years. It could also offer insight into whether participants share what they have learned with their communities, and gauge overall behavioral change in the population.

Adding application questions

1. How did you hear about us?

This question may help to keep track of which avenues of communication are working (and conversely, which are not). For example, if certain avenues of communication such as posters are never mentioned by applicants, then perhaps the poster would need to be enhanced. Another example would be if the majority of participants who drop out early in the program had been brought into the program via posters, perhaps the poster is ineffectively communicating what EcoFutures does and is for.

2. Note: Please answer all questions to the best of your abilities to be considered.
Many people failed to complete the application in its entirety. This may mean that applicants don't realize that all questions are mandatory, or perhaps the question needs to be rephrased because it was hard for people to understand.

All of these monitoring and evaluation tools can help to shed more light on the hypotheses proposed in this report.

Funding Constraints

The final logistical issue we discovered, unsurprisingly for a program run by NGOs, was a lack of adequate funding. In a conversation with Nicky, she told us that if she had enough funding she would dedicate full-time staff to EcoFutures. Amos also revealed that the current funding sources “don’t really understand the world here.” Funding, therefore, is a two-sided issue; its insufficiency restricts what the implementers can do, and the lack of understanding between the people on the ground and the funding organizations creates unnecessary hurdles. The people involved in the pilot have been working incredibly hard within these constraints, but we wanted to come up with some strategies to help ease them as well.

In the short term, we recommend that EcoFutures clarifies its scope to focus on a smaller geographic area. By attempting to reach youth throughout the district at this early phase, the implementers are spreading themselves too thin and therefore becoming less effective. In the long term, once EcoFutures does have the framework built to easily expand, we hope more funders can be engaged via the marketing tools (video and infographic) we have put together. Ideally, these materials will both draw more funders in, and help them understand the realities of EcoFutures and the Alfred Nzo District.

Overarching Concerns

Our group also identified several larger-scale concerns, specifically ineffective outreach, a disconnect in communication and understanding between program implementers and participants, and a lack of diversity in the participants’ business proposals.

Ineffective Outreach

So far, the EcoFutures team has primarily used posters and social media to spread awareness for the program. They have placed these posters in schools, businesses, and meeting places, and advertised on the UCPP Facebook page. They have also visited some schools and villages directly, and passed information regarding the program to teachers, principals, and traditional chiefs. While these efforts were definitely valuable for the pilot program, they often did not directly reach youth, especially in rural areas. Most youth outside of Matatiele itself do not have access to computers or internet to view social media, and many do not pay attention to posters. Additionally, some interviewees reported that sometimes teachers, principals and chiefs did not actually pass along the information. Some youth also avoid traditional meetings or community gatherings where this information would be shared, and a large portion of EcoFutures’ target audience is no longer in school. As a result, only one of the rural youth we spoke to in Colana had heard of EcoFutures. Similarly, most current participants had originally heard via word-of-mouth. Though we did not interview youth in other remote communities, we hypothesize that this trend extends throughout the remote areas of the district as well.

To address this issue, we recommend that EcoFutures adjust its outreach efforts to focus on speaking directly with youth. This could be implemented through classroom visits, or spreading advertising materials through existing youth organizations like soccer or music programs, as several Colana students reported these programs as active in their areas. Bongie

also suggested looking into developing youth clubs or organizations to facilitate outreach, and to empower the youth in general.

We recognize that Tsoanelo and Amos are already stretched thin with the demands of this program, and as a result asked some of the current participants if they would be interested in acting as an “EcoFutures Ambassador” to their communities. As an ambassador, they would raise awareness for the program and share some of the knowledge through meetings and presentations. All of the participants asked replied with an enthusiastic yes. Implementing this “EcoFutures Ambassador” program would hopefully meet EcoFutures’ goals of effective outreach, widespread behavioral change, and dissemination of environmental information.

Lack of Communication and Understanding

Communication also came up in our research as an overarching concern, in addition to a logistical hurdle. In our conversations regarding challenges facing EcoFutures, Tsoanelo and Amos both emphasized a communication gap between themselves and the participants. They felt that the participants did not sufficiently communicate their needs and challenges within the program. Additionally, when we shared some preliminary findings from participant interviews with them, they expressed that they wished they could hear this feedback from the participants directly. On the other hand, Bongie emphasized that the EcoFutures partners overall have not been able to put in enough effort to really understand the participants. She reported that she is the only one who consistently sits down with the youth to discuss their expectations and goals on a personal level. As an informal mentor and community leader in Colana, Bongie is incredibly influential in EcoFutures. We think having more people like her could close the communication gap between implementers and participants, and also offer participants with more role models.

Engaging with participants in this way takes significant time and effort, and Bongie, Tsoanelo and Amos cannot do it alone. Therefore, we propose that EcoFutures harness the power of the UCPP to create a mentorship structure for the participants starting in Phase 1. Members of UCPP partner organizations could volunteer to act as mentors for small groups of youth for the duration of the program. These mentors would act as primary information conduits between the participants and implementers, and be responsible for following up if a participant missed a session or was otherwise struggling. They could also meet regularly with their mentees, and pass along any concerns to the implementers. To test the viability of this idea, we asked some of the partners we interviewed if they would be interested in serving as a mentor, and like the participants with the ambassador program, all of them responded with an enthusiastic yes. While the mentorship structure may need further development to introduce more incentives to participate, we hope engaging the UCPP in this way would improve overall communication and better support both the participants and the implementers. This structure could also act as a monitoring and evaluation tool.

Diversity in Green Business Proposals

EcoFutures was extremely effective in empowering participants to become involved in starting green economy businesses. Upon entering EcoFutures, only 50% of the participants expressed a desire to start their own business. By the end of Phase 1, all of the participants expressed this desire, and many have developed business proposals to do so. A handful have even begun to execute these businesses. While this attests to the success of the program, many of the participants reported wanting to start the same type of businesses. Despite coming into EcoFutures with different business plans and dream jobs, participants often assimilated to the

sectors heavily emphasized in the EcoFutures training program. This is suggestive of a bottleneck effect on ideas and innovation. Of the 10 participants we interviewed, four individuals indicated aspirations to create a charcoal production business, three intended to create a waste management business, and the remaining three were interested in ecoranging, biogas, and ecotourism respectively. Furthermore, many participants indicated a desire to pursue multiple businesses. Lack of specialization and redundancy could lead to lower business viability, due to limited buyers in a competitive market.

To diversify beyond the limited niche sectors proposed by participants thus far, we recommend an increased variety of trainings. EcoFutures seeks to create green economy partnerships with waste management, ecotourism, biomass, renewable energy, and rangeland management businesses. However, EcoFutures has been unable to execute the intended range of trainings thus far. With continued expansion of the program and the formation of more partnerships, it will be possible to expand beyond the niche businesses and trainings. A greater emphasis on integrating green practices in non-green economy businesses may further promote diversity in entrepreneurial ventures. Likewise, more emphasis on the potential for participants to come up with their own green business, including ideas they had prior to coming to EcoFutures, could help diversify the output of business ideas.

In order to better understand the business aspirations of rural youth, we asked the 26 youth we interviewed if they hoped to open a business and if so what type of business. Of the 14 youth who had clear preferences of what type of business they would like to open, nine indicated they would like to open a business selling fruits and vegetables. While our sample size was small, this suggests a large population of youth may be interested in working in the agricultural industry. Consequently, it would be beneficial to include trainings focused on sustainable agricultural practices in the curriculum of EcoFutures. To connect youth to the formal market, it may also be valuable to integrate a farmer's market into the livestock auctions.

III. Data Limitations

Our data was limited by several confounding variables: the language barrier between interviewers and rural interviewees, the interview location, and a small sample size with limited geographic diversity.

Language Barrier - translator variations and understanding of questions

Translators assisted with interviews of the rural youth in Colana. The translators had varying levels of English fluency, and therefore potentially different interpretations of questions. They were sometimes unaware of the intent behind questions and prompted interviewees with examples if they appeared confused. Some questions were therefore potentially misconstrued, and because we cannot be sure of exactly what was said, the resulting data is unreliable. In the future, using the same translator for all interviews or meeting with translators beforehand to agree on the translation of questions could enhance data validity.

Interview Location

Interviews with rural youth in Colana varied in location. On the first day, interviews were conducted outside the local Chiefs' house in the morning and at a local school in the afternoon. The second day, interviews were conducted at a heritage celebration, and in a room in the local

Chiefs' house. The different locations entailed different social situations and pressures, potentially impacting interviewees' answers.

Sample Size and Limited Geographic Diversity

Only 26 rural youth were interviewed, as well as only ten participants. A larger sample size would enhance data quality by reducing the impact of confounding variables. Additionally, all rural youth interviewed were from Colana or areas near in proximity. Therefore, results are difficult to generalize to all rural youth in Alfred Nzo District.

Due to the various issues encountered during data collection, our conclusions are more hypotheses into ways the program can be improved. We hope further research can expand on our findings and work to limit the confounding variables.

CONCLUSION

We aimed to assess the impact of EcoFutures and to propose innovative solutions to problems encountered to assist with preparations for the next cycle of participants. Through structured interviews with participants, we discovered the pilots' immense benefits including: addressing a skills gap in the Alfred Nzo District, empowering youth, facilitating environmental stewardship, and fostering business development in the green economy. We discovered several fundamental challenges facing EcoFutures including: transportation issues, lack of communication, ineffective youth outreach, business feasibility issues, and lack of funding and manpower. We suggested and created solutions for each problem, and created improved marketing materials and monitoring tools for continued investigation into improving the pilot project.

In the short term, we recommend implementation of proposed solutions and utilization of improved marketing tools. In the long term, EcoFutures should aim to expand into more rural areas of the Alfred Nzo District.

ACKNOWLEDGMENTS

We would like to extend a special thank you to Tsoanelo Shata, Amos Siphumelele, Nicky McLeod, Bongie Mafuya, the Dartmouth program coordinators, and our interpreters and homestay hosts for making this project possible. We could not have conducted our interviews without your support, and we are grateful to have had the opportunity to contribute to such an inspiring program.

Understanding Wattle Seed Bank Dynamics

By Rafael Rosas, Eleanor Bates, Brody McNutt, Lynette Long, Clare Doherty & Thoza Yapi

INTRODUCTION

Wattle, an invasive species from Australia, was introduced to South Africa in the 1800s. This opportunistic tree species quickly spread across the Eastern Cape and began to outcompete native plants and alter hydrological regimes in the Umzimvubu catchment area. This mountainous region is of critical importance to the many villages which rely on the freshwater captured by snowmelt, fog, and rain at high elevations.

The government, with the help of environmental scientists, has identified wattle as having a negative impact on local water security and has partnered with NGO's to begin removing the stands within the drainage basin. The Umzimvubu Catchment Partnership Program (UCPP) is a voluntary association formed to tackle this problem.

GOALS

The goal of this project was to help the UCPP investigate the variables that affect wattle growth and regrowth. Wattle forest regrowth can occur after clearing efforts via re-sprouting from roots, or new growth from seed banks. We sampled soils at three different sites to consider the effect of the following variables and their impacts on seed abundance: elevation, slope, aspect, soil type, soil firmness, effect of clearing, effect of burning, and effect of trampling. There were two locations with active Working for Water teams in Mzongwana (Team 1 and Team 5) and a previously cleared and trampled site in Motseng that were used to sample soil.

We also used anecdotal evidence from interviews with members of wattle-clearing teams to investigate whether these individuals perceived any noticeable patterns that could explain discrepancies between areas with high levels of wattle regrowth and those with little regrowth. This research could inform future clearing efforts by identifying areas where wattle may regrow less aggressively after cutting. Additionally, it may more generally help improve wattle management strategies by informing decision-makers on how wattle behaves and reacts to specific factors. Our project was intended to lay the groundwork for future, more comprehensive investigations that will be able to more conclusively direct the way wattle is managed in the Umzimvubu catchment area, and perhaps more broadly in South Africa.

PREDICTIONS

We formed three preliminary predictions about variables we believed would have the most significant effects on regrowth based on interviews with local experts and leaders of NGO's: 1) that wattle seed abundance and regrowth would be more prevalent at lower altitudes because rain and the resulting erosion may transport seeds down a slope 2) that burning would result in increased regrowth, as fire can stimulate seed germination, and 3) that trampling by livestock would decrease the viability of wattle seed banks by fertilizing and loosening the soil to facilitate the growth of native species that provide competition pressure.

PROTOCOL

In order to investigate the variety of variables we were interested in at the three sites we sampled from, we classified sites into areas with different altitudes and treatment types ("sample

area categories”). Our procedure was repeated three times at each sample area category with sites chosen at least thirty meters apart so we could find an average for each category. We then identified and recorded the parameters of the sample area according to team number, slope, direction of slope, elevation, latitude and longitude, and whether the area had been burned, cleared, and/or trampled. Next, we dug a hole with an augur to a depth of ten centimeters and collected a set volume of soil to analyze in a plastic bag.

To test for soil firmness, we used a shovel to break up the topsoil at an area near the sample site. Then, we chose a representative clump of soil and squeezed it between the thumb and middle finger to record the soil firmness on a scale of 1 (least firm) to 5 (most firm). We also recorded observations about how moist and well sorted the soil was. To test for soil color, we used the Munsell Soil Color Chart to match a chip hue, value, and chroma for both dry and wet soil samples from the same square of soil. For the wet sample, we simply moistened the dry sample with a few drops of water from the squeeze bottle.

To count the wattle seeds, we took one standard scoop of soil (just over $\frac{1}{2}$ cup, $\sim 172\text{ cm}^3$ in volume) from the plastic bag so that we could find the number of seeds for a controlled soil volume. We put the scoop of soil onto a sorting tray and took a picture of it with the sample area characteristics written on a whiteboard for future use. We then used tweezers, sieves, and paintbrushes to sort through the soil sample and find all of the wattle seeds. We recorded the number of seeds found in the soil sample and calculated the averages over each sample area category.

Additionally, at each site we visited, we interviewed between four and nine people who worked with clearing wattle. We used a standard, multiple-choice questionnaire and an English-Xhosa translator when necessary (Appendix A).

CAVEATS

The methods adopted for this project were meant to provide a broad, general, initial overview. The data are not meant to provide definitive conclusions, and as a result there are many caveats that should be recognized. One of these caveats was that we did not know the standard error of the measuring devices used to measure aspect, elevation, and latitude and longitude coordinates. We also used a different GPS on the last day of sample collection. In addition to these technical errors, there were also human errors, including the possibility of missing wattle seeds when they were counted by hand. Slope and firmness measurements were subjectively estimated rather than quantitatively measured, and slope was not measured at all at the Team 1 site.

Furthermore, it rained the second day of testing, which dampened soil samples and made soil identification less precise. We were not able to collect samples from one of the locations because a lightning storm forced us to evacuate the top of the mountain for safety reasons before being able to collect samples. Other caveats include that the standard depth of augur cores were not perfectly consistent, the differences between black, silver, and green wattle were not noted, and the stands from the Team 5 site in Mzongwana were older than those of Team 1.

DISCUSSION OF RESULTS

In our interview results, we found that the majority of people believed that wattle both grew and regrew at lower altitude regions (Fig. 1). People attributed this trend to increased soil moisture and closer proximity to streams at lower elevations, as well as seeds transport down the slopes of hills during rainfall. We found that people predominantly believed that wattle thrived

in red loam soil because it is more nutritious and has better water retention (Fig. 2). For burning, our results showed that a two-thirds majority of people believed that a burning event would make wattle regrow better (Fig. 3). Additionally, most people believed that younger wattle stands would regrow better than older ones because the younger roots are thinner and grow deeper into the soil; therefore, they are harder to remove than older roots which are larger and more spread out. Some respondents stated that younger wattle stands could have more abundant seed banks, although others cited increased seed banks as justification for older wattle stands regrowing better. People had mixed reviews on the effectiveness of the method of clearing, although most people said that manual-mechanical removal was more effective than chemical herbicides because the roots could be identified and removed.

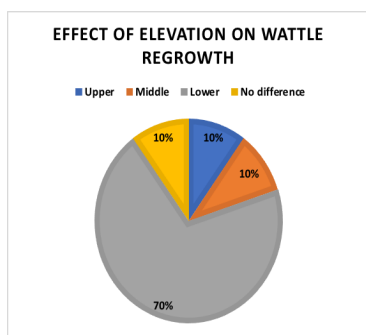


Figure 1: Effect of elevation on regrowth

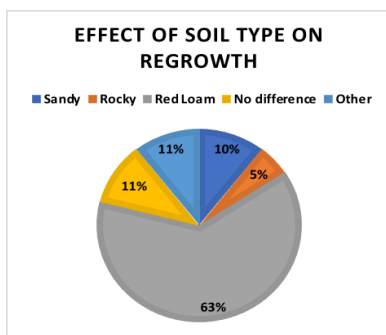


Figure 2: Effect of soil type on regrowth

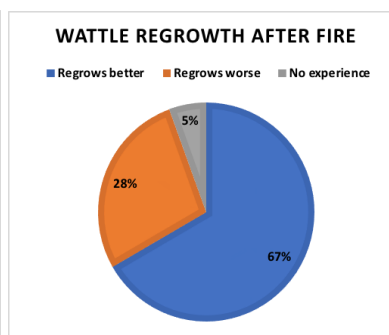


Figure 3: Effect of burning on regrowth

As previously stated in this paper, the purpose of our research was to establish a preliminary understanding about variables affecting wattle regrowth that would be able to inform future research. The findings of our research are not definitive or conclusive, but rather reveal insights for better wattle management and guide the direction future research should head in. Our initial findings suggest that the most promising variables with an effect on wattle regrowth are the factors that contribute to the soil color of the area and the aspect of the region where the wattle is growing.

While it is generally known that wattle does very poorly after a certain elevation (about 1750 meters), the data we collected did not suggest that there was any major correlation between elevation and wattle regrowth outside of one singular relationship since the R^2 value was only 0.0516 (Fig. 4). Contrary to the popular belief of interviewed individuals, burning the land after clearing also seemed to have no statistically significant impact on the wattle seed bank abundance of a region (Fig. 5). While our qualitative data from surveys seemed to suggest that land burning did have some impact on wattle regrowth, our quantitative data suggested that there was no difference between the seed banks of cleared unburnt land and cleared burnt lands. Our findings also showed that the cleared land examined for follow-up had far fewer seeds than uncleared land when the two were compared (Fig. 6). This suggests that the clearing and follow-up methods are effective in reducing seed banks.

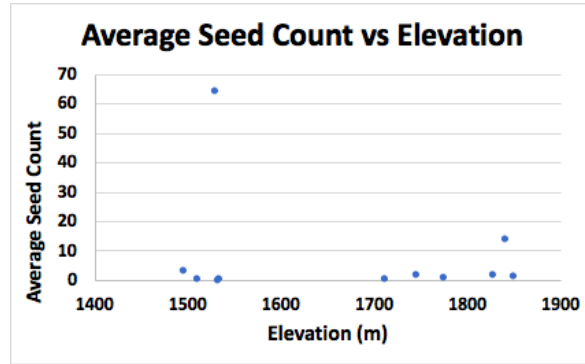


Figure 4: Average Seed Count vs. Elevation, $R^2 = 0.0516$

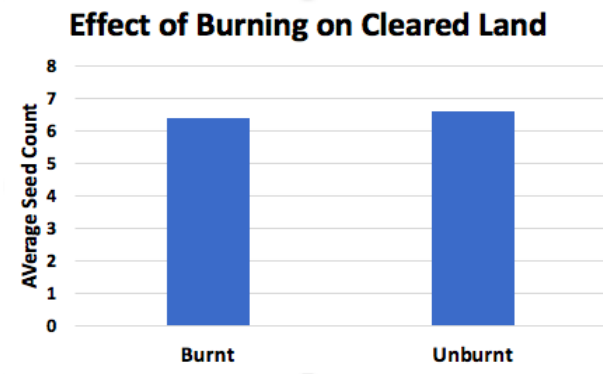


Figure 5: Effect of burning on average seed count in cleared land

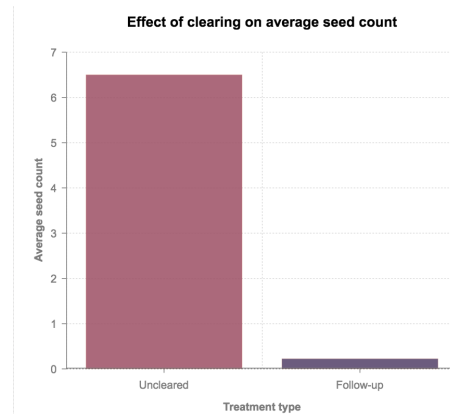


Figure 6: Effect of clearing on average seed count

Our findings also showed that there was no real correlation in the overall data between soil firmness and seed abundance (Fig. 7). If there were, we would expect to see some kind of consistent pattern either along a single firmness measure (i.e. small standard deviation along firmness lines) or a general slope through all firmness measures - both are absent. This may have resulted because firmness was measured subjectively and imprecisely, but it is more likely that there was simply no correlation. At the highest altitudes measured, particularly at elevations approaching 1750 meters, the elevation at which wattle no longer grows, it appeared that there was a correlation between soil firmness and seed count. As the firmness of the soil increased at high elevations, the seed count seemed to decrease almost linearly to zero (Fig. 8). While this relationship may suggest a correlation, it is unlikely, based on our small sample size of four core samples.

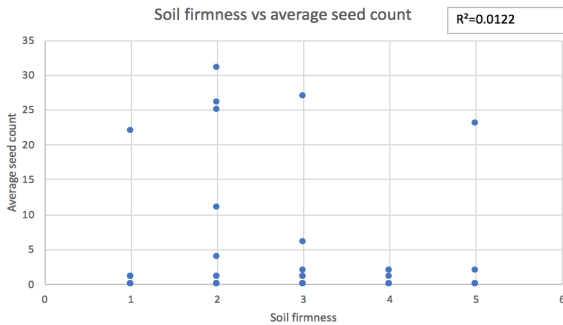


Figure 7: Soil firmness vs. average seed count

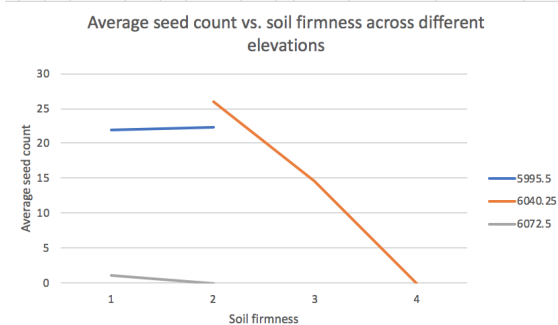


Figure 8: Average seed count vs. soil firmness across different elevations

One of the potentially promising variables that were tested for is the type of soil found in the landscape as it relates to the abundance of wattle seed banks. The qualitative data from our surveys suggested that red loam soil was the kind of soil wattle regrew best in, based on the beliefs of local people. However, our quantitative data suggested that the exact opposite could be true. Using a 1975 edition of the Munsell Soil Color Chart to identify the kinds of soils, we found that very dark brown (dry) and black soils (wet) were the soil types with the highest seed count, whereas red soils, such as the kinds expected by locals to have the most seeds, in fact had the least seeds in both wet and dry conditions (Fig. 9). It is important to note that these data could be the result of human faults in our collection process, as our survey was not comprehensive and soil color was identified subjectively. We would suggest, though that the relationship between soil type and wattle regrowth success be investigated more comprehensively to address this discrepancy in qualitative and quantitative findings, with specific attention placed on the individual factors which contribute to soil color and type: climate, time since deposition, topography, presence of parent materials, and presence of organic matter. It is also worth noting that David Le Maitre, a South African wattle expert who works with CSIR, mentioned in a phone interview that he did not think the specific soil composition—beyond just rocky or not rocky—would have a notable effect on wattle success; this is because wattle thrives in a variety of marginal environments and because it is a legume, capable of fixing its own nitrogen.

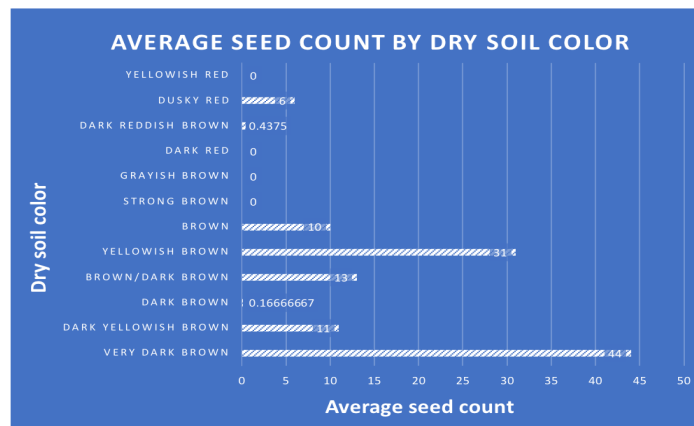


Figure 9: Average seed count by dry soil color

Facilitating the trampling of land after it had been cleared may have reduced the seed bank when compared to controlled untrampled lands, but this observation was based off a small

sample size, and the untrampled land had very few wattle seeds to begin with. Thus, the difference is not robust. Though the quantitative data is statistically insignificant, the trampled areas qualitatively appeared to be healthier, and had better grass presence which could compete with wattle and limit regrowth.

The last variable with a potentially significant influence on wattle seed abundance is aspect. We documented which way the downward slope was facing at each soil sample site and analyzed that directional data against seed count and found an interesting pattern. When plotted on a radial graph, we found more seeds in samples from southern-facing slopes, particularly southwestern-facing slopes, controlling for the number of sample sites that were north-facing and south-facing (Fig. 10). After consulting with Mme Sissie, the founder of Environmental and Rural Services, we learned that southern-facing slopes better accumulated organic residues, so this may be a potential explanation for the more abundant seed banks. The data here suggests the most promising correlation that might inform future wattle management. We will next explicate on these results and formulate recommendations for future research and clearing efforts based on our preliminary evidence.

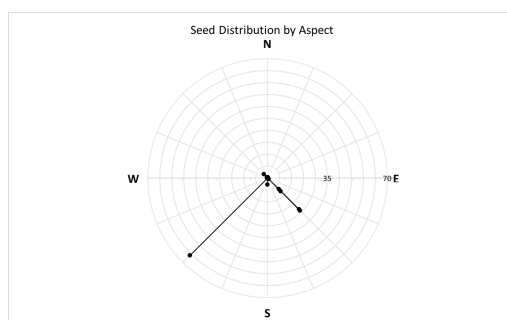


Figure 10: Seed distribution by aspect

CONCLUSION

When wattle was first introduced to the African continent in the 1800s, it served an important role as a source of firewood and building material for settlers. However, because wattle was already adapted to Australia's arid climate and it lacked natural predators in Southern Africa, it quickly spread beyond the region it was introduced to and began to alter the existing ecosystem dynamics. Today, wattle is widespread and places strains on water resources across the country, placing a significant burden on the livelihoods of communities—including those within the Umzimvubu catchment area. Over the past week, we collected soil samples across a range of different environments within the catchment, quantitatively evaluated the wattle seed presence within these sample sites, and administered surveys to those employed by wattle-clearing initiatives. We assessed our seed bank data in search of correlations between variables such as elevation, soil type, and clearing treatment by measuring seed abundance; our surveys provided us with information regarding the perceptions that locals involved in wattle-clearing had towards the factors influencing success of wattle regrowth.

RECOMMENDATIONS

Our methodology was designed with the intent to establish a basis for further research rather than to provide a comprehensive understanding of the factors contributing to wattle

regrowth success—we aimed more at breadth than depth. Through this process, we developed areas for potential future research. Firstly, we would recommend repetition of the techniques mentioned herein with special attention paid to the issues raised in the section regarding caveats to our findings. Secondly, we would suggest that additional investigation be done into the role played by slope/aspect as this was the variable that we found to have the strongest relationship to wattle regrowth. We would also recommend looking into livestock trampling where possible, particularly to influence grass growth. Additionally, we would like to put forth a variety of other factors which could be assessed in relation to wattle regrowth: precipitation, temperature, water retention, wattle stand age, topography, investment in vegetative reproduction vs. seed production, humidity, root density, and nutrient level. Lastly, we think that studying sprouting success may yield more valuable information than simply seed presence—this is especially important for silver wattle, which can resprout from roots, unlike black wattle which depends entirely on seed banks for regrowth. Although our study was limited by resources, site accessibility, and—more than anything else—time, we hope that we have helped to pave the way for future research to more accurately assess the factors influencing wattle resilience. Through careful evaluation and informed policy, we hope that the Matatiele Local Municipality and the wider Alfred Nzo District can serve as a trailblazer for effective wattle management and improve efforts to reverse the ecological, social, and economic damages that have been inflicted as a result of wattle’s introduction hundreds of years ago.

BACKGROUND RESEARCH

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- Ngorima, A. and C.M. Shackleton. “Livelihood benefits and costs from an invasive alien tree (*Acacia dealbata*) to rural communities in the Eastern Cape, South Africa.” *Journal of Environmental Management*, 2018.
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- Richardson, David M. and Robert L. Kluge. “Seed banks of invasive Australian *Acacia* species in South Africa: Role in invasiveness and options for management.” *Perspectives in Plant Ecology, Evolution and Systematics*, vol. 10, 2008, pp. 161–177.
- Yapi, Thozamile Steve, et al. “Alien tree invasion into a South African montane grassland ecosystem: impact of *Acacia* species on rangeland condition and livestock carrying capacity.” *International Journal of Biodiversity Science, Ecosystem Services & Management*, vol. 14, no. 1, 2018, pp. 105–116.

Appendix A - Questionnaire re: variables affecting wattle regrowth

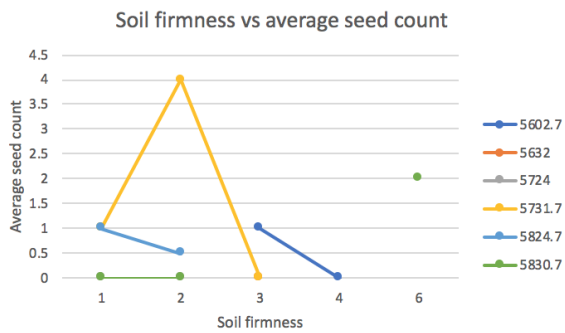
Age:

Gender:

1. *How many years have you been working on clearing wattle?*
 - A. *Less than 1 year*
 - B. *1 year*
 - C. *2 years*
 - D. *3 or more years*
2. *How long have you lived in this area? _____*
3. *To your knowledge, how long has wattle been in this area? _____*
4. *What altitude have you noticed wattle grows best? Why?*
 - A. *Upper altitudes*
 - B. *Middle altitudes*
 - C. *Lower altitudes*
 - D. *Haven't noticed a difference*
5. *What altitudes have you noticed wattle regrows in best, after it's been cut? Why?*
 - A. *Upper altitudes*
 - B. *Middle altitudes*
 - C. *Lower altitudes*
 - D. *Haven't noticed a different*
6. *What soil types have you noticed wattle regrows in best? Why?*
 - A. *Rocky soil*
 - B. *Sandy soil*
 - C. *Red loam soil*
 - D. *Haven't noticed a difference*
7. *Have you noticed if wattle regrows better or worse after it has been burned? Why?*
 - A. *Regrows better*
 - B. *Regrows worse*
 - C. *No difference*
 - D. *No experience with burnt areas*
8. *Have you noticed if older or younger wattle stands have regrown better?*
 - A. *Older wattle (greater than 2 years)*
 - B. *Younger wattle (2 years or less)*
 - C. *Haven't noticed*
9. *What method of clearing is most effective? Why?*
 - A. *Manual-mechanical cutting*
 - B. *Chemical herbicide*
10. *Are there any other characteristics of areas with high wattle regrowth?*

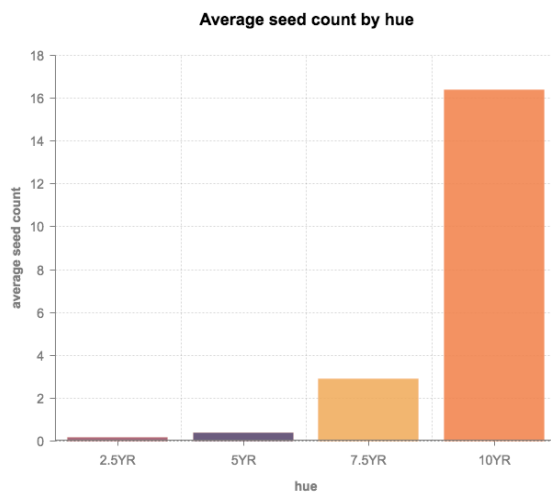
Appendix B - Supporting graphs and charts assessing variables affecting wattle regrowth

Soil Firmness

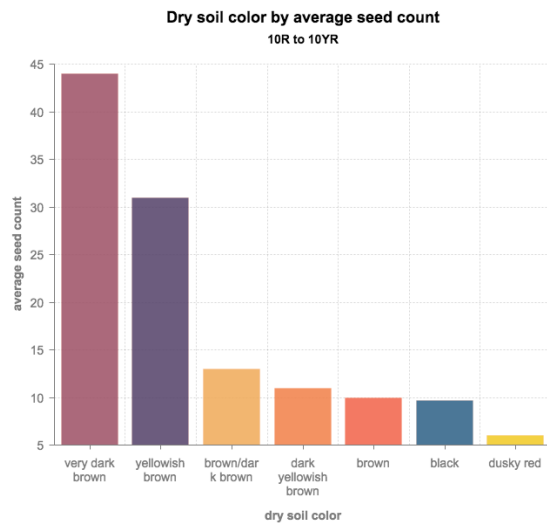


Effects of soil firmness on seed count, controlling for elevation

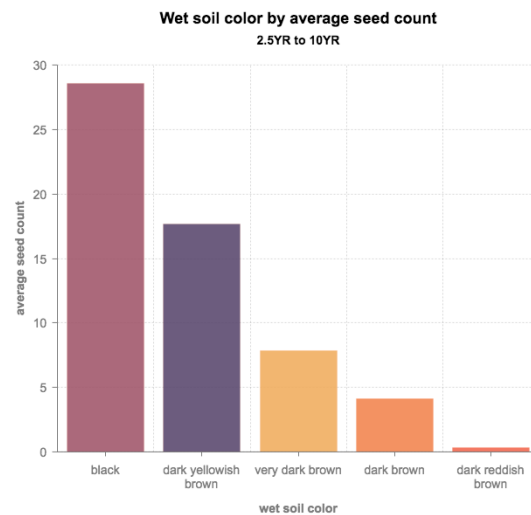
Soil Color



Effects of hue on average seed count



Effects of dry soil color on seed abundance



Effects of wet soil color on seed abundance

Appendix C - Data recorded from soil samples

Date 9/19/18										
Site/Team	Burnt	Cleared	Aspect	Altitude (ft)	Altitude type	Coordinates	Soil Firmness	Soil Color Dry	Soil Color Wet	Seed count
1 Y	N	N	SE	6071	high	S30.063623, E29.016025	2	10YR 5/2 grayish brown	10YR 2/2 very dark brown	0
1 N	N	N	SE	6071	high	S30.062892, E29.016691	1	7.5YR 5/2 brown	10YR 3/3 dark brown	1
1 N	N	N	SE	6071	high	S30.061567, E29.016175	4	10YR 5/3 brown	10YR 2/2 very dark brown	2
1 N	N	N	SE	6077	high	S30.06079, E29.06597	2	10YR 5/2 grayish brown	10YR 3/3 dark brown	0
1 N	N	N	SE	6040	middle	S30.063451, E29.016913	2	10YR 4/3 brown/dark bro	10YR 3/3 dark brown	26
1 N	N	N	SE	6037	middle	S30.063131, E29.01702	3	10YR 4/3 brown/dark bro	10YR 3/3 dark brown	2
1 N	N	N	SE	6044	middle	S30.062789, E29.016898	4	10YR 5/2 grayish brown	10YR 3/2 very dark grayis	0
1 Y	N	N	SE	6040	middle	S30.064058, E29.015963	3	10YR 5/3 brown	10YR 2/2 very dark brown	27
										9.3333333
1 Y	N	N	SE	5982	low	S30.064651, E29.016154	2	10YR 4/3 brown/dark bro	10YR 2/2 very dark brown	11
1 N	N	N	SE	6000	low	S30.064328, E29.016500	2	7.5YR 4/4 brown/dark brc	7.5YR 3/4 dark brown	25
1 N	N	N	SE	5997	low	S30.063949, E29.017015	2	10YR 5/4 yellowish browr	10YR 3/4 dark yellowish t	31
1 N	N	N	SE	6003	low	S30.063534, E29.017392	1	10YR 4/4 dark yellowish t	10YR 3/6 dark yellowish t	22
										26
Date 9/20/18										
Date 9/20/18										
Site/Team	Burnt	Follow up	Aspect	Altitude (ft)	Altitude type	Coordinates	Soil Firmness	Soil Color Dry	Soil Color Wet	Seed count Slope
5 N	Y	Y	SE	5836	high	S30.084244, E29.094375	2	10YR 4/6 dark yellowish t	10YR 3/6 dark yellowish t	0 1
5 N	Y	Y	SE	5828	high	S30.05064, E29.05639	6	5YR 3/3 dark reddish brov	5YR 3/3 dark reddish brov	2 1
5 N	Y	Y	SE	5828	high	S30.05076, E29.05594	1	5YR 4/6 yellowish red	5YR 3/4 dark reddish brov	0 1
										0.6666667
5 N	N	N	SE	5825	high	S30.050819, E29.05526	2	5YR 3/2 dark reddish brov	5YR 3/4 dark reddish brov	1 1
5 N	N	N	SE	5824	high	S30.05103, E29.05503	2	5YR 3/3 dark reddish brov	5YR 3/4 dark reddish brov	0 0
5 N	N	N	SE	5825	high	S30.05113, E29.05486	1	2.5YR 3/4 dark reddish br	2.5YR 2.5/4 dark reddish l	1 0
										0.6666667
5 N	Y	Y	NW	5723	middle	S30.05026, E29.05368	1	2.5YR 3/4 dark reddish br	2.5YR 2.5/4 dark reddish l	0 3
5 N	Y	Y	NW	5723	middle	S30.05040, E29.05346	1	10R 3/4 dusky red	10R 3/4 dusky red	0 3
5 N	Y	Y	NW	5726	middle	S30.05056, E29.05328	2	2.5YR 3/4 dark reddish br	2.5YR 2.5/4 dark reddish l	0 2
										0
5 N	N	N	N	5726	middle	S30.05010, E29.05387	3	5YR 4/6 yellowish red	2.5YR 2.5/4 dark reddish l	0 1
5 N	N	N	N	5731	middle	S30.05002, E29.05400	1	5YR 3/3 dark reddish brov	5YR 3/3 dark reddish brov	1 1
5 N	N	N	S	5738	middle	S30.04888, E29.05500	2	10YR 2/1 black	10YR 2/1 black	4 2
										1.6666667
5 N	Y	Y	NNW	5643	low	S30.04962, E29.05235	3	7.5YR 3/2 dark brown	7.5YR 3/4 dark brown	0 1
5 N	Y	Y	NNW	5628	low	S30.04972, E29.05213	3	2.5YR 3/4 dark reddish br	2.5YR 3/4 dark reddish br	0 1
5 N	Y	Y	NNW	5625	low	S30.04983, E29.05189	3	2.5YR 2.5/4 dark reddish l	2.5YR 2.5/4 dark reddish l	0 2
										0
5 N	N	N	NW	5601	low	S30.04998, E29.05148	4	5YR 3/4 dark reddish brov	5YR 3/4 dark reddish brov	0 3
5 N	N	N	NW	5607	low	S30.05016, E29.05136	4	2.5YR 3/6 dark red	2.5YR 3/4 dark reddish br	0 3
5 N	N	N	NNW	5600	low	S30.05026, E29.05113	3	5YR 3/4 dark reddish brov	5YR 3/3 dark reddish brov	1 5
										0.333333
Date 9/22/18										
Site/Team	Burnt	Cleared	Aspect	Altitude (ft)	Altitude type	Coordinates	Soil Firmness	Soil Color Dry	Soil Color Wet	Seed count Slope
Mots	N	N	N	5395		S30.16860, E28.22286	3	5YR 3/3 dark reddish brov	5YR 2.5/2 dark reddish brown	2
Mots	Y	Y	SSW	5027		S30.17025, E28.22227	4	5YR 3/2 dark reddish brov	5YR 2.5/2 dark reddish br	0 1
Mots	Y	Y	SW	5024		S30.17017, E28.22212	5	5YR 3/2 dark reddish brov	7.5YR 3/2 dark brown	0 2
Mots	Y	Y	SSW	5034		S30.17008, E28.22227	4	10YR 2/2 very dark brown	7.5YR 2/0 black	0 1
										0
Site/Team	Burnt	Cleared w/	Aspect	Altitude (ft)	Altitude type	Coordinates	Soil Firmness	Soil Color Dry	Soil Color Wet	Seed count Slope
Mots	N	Y	SW	5017		S30.17024, E28.22437	4	10YR 2/2 very dark brown	10YR 2/1 black	0 4
Mots	N	Y	SSW	5021		S30.17024, E28.22456	5	10YR 2/1 black	10YR 2/1 black	23 4
Mots	N	Y	SW	5017		S30.17024, E28.22475	4	10YR 2/2 very dark brown	10YR 2/1 black	170 4
										64.33333
Site/Team	Partially cl	River	Aspect	Altitude (ft)	Altitude type	Coordinates	Soil Firmness	Soil Color Dry	Soil Color Wet	Seed count Slope
Mots	Y	Y	NW	4908		S30.17196, E28.23175	4	10YR 3/3 dark brown	10YR 2/1 black	1 3
Mots	Y	Y	NNW	4905		S30.17190, E28.23190	5	10YR 2/1 black	10YR 2/1 black	2 7
Mots	Y	Y	NW	4915		S30.17220, E28.23141	3	10YR 2/2 very dark brown	10YR 2/2 very dark brown	6 6
										3
Site/Team	Burnt	Cleared	Trampled	Aspect	Altitude (ft)	Coordinates	Soil Firmness	Soil Color Dry	Soil Color Wet	Seed count Slope
Mots	N	Y	N	NNW	4946	S30.17282, E28.23130	3	5YR 3/4 dark reddish brov	5YR 3/3 dark reddish brov	1 3
Mots	N	Y	N	NNW	4950	S30.17284, E28.23145	5	7.5YR 4/6 strong brown	7.5YR 3/4 dark brown	0 1
Mots	N	Y	N	NNW	4959	S30.17293, E28.23135	5	5YR 3/3 dark reddish brov	7.5YR 3/2 dark brown	0 0
										0.333333
Mots	N	Y	N	NNE	5050	S30.288245, E28.377081	2	7.5YR 4/4 dark brown	7.5YR 3/2 dark brown	0 1?
Mots	N	Y	N	NNE	5031	S30.288115, E28.376842	2	10YR 4/3 brown/dark bro	10YR 2/2 very dark brown	1 1?
Mots	N	Y	N	NNE	5044	S30.288274, E28.376903	1	5YR 4/6 yellowish red	5YR 3/3 dark reddish brov	0 1?
										0.333333
Mots	N	Y	Y	NNW	4952	S30.17284, E28.23124	5	7.5YR 4/4 brown/dark brc	5YR 3/3 dark reddish brov	0 1?
Mots	N	Y	Y	NNW	4957	S30.17287, E28.23110	5	5YR 3/3 dark reddish brov	5YR 2.5/2 dark reddish br	0 1
Mots	N	Y	Y	NNW	4964	S30.17297, E28.23119	2	7.5YR 4/6 strong brown	7.5YR 3/4 dark brown	0 1
										0
Mots	N	Y	Y	NNE	5025	S30.288270, E28.377167	3	7.5YR 3/4 dark brown	7.5YR 3/2 dark brown	0 2
Mots	N	Y	Y	NNE	5041	S30.288429, E28.377445	3	7.5YR 3/4 dark brown	7.5YR 3/2 dark brown	0 2
Mots	N	Y	Y	NNE	5025	S30.288494, E28.377221	3	5YR 4/6 yellowish red	5YR 3/3 dark reddish brov	0 1/2?
										0

Appendix D - Soil firmness and slope keys

<u>Soil Firmness</u>
1 soil very easily crumbled
2 soil easily crumbled
3 soil crumbled
4 soil offered tension before crumbling
5 soil did not crumble

<u>Slope</u>
1 horizontal
5 45 degrees
10 vertical

Socio-Economic Impacts of ‘Landscapes and Livelihoods’

By Allie Banks, Hanna Bliska, Jade Bravo, and Alyssa Gao

INTRODUCTION

Local Partner Description

We spent the week working with Meat Naturally Pty (MNP), a social enterprise that seeks to provide private market incentives for local livestock owners in order to promote the conservation of rangelands in rural villages within the Umzimvubu Catchment area. In understanding that interventions can simultaneously promote conservation and sustainable land-use, MNP harnesses the private market to provide fair value for cattle that graze on locally managed lands. MNP aims to facilitate both land restoration and market sales services in these communities. To achieve this goal, they provide access to a mobile cattle auction and incentivize local livestock owners to join grazing associations by offering benefits such as vaccines for cattle, lower commission rates, and training for members. In turn, these grazing associations sustainably manage rangelands through a rotational grazing system.

MNP works in conjunction with other NGOs associated with the Umzimvubu Catchment Partnership Programme (UCPP), such as Environmental and Rural Solutions (ERS) and Conservation South Africa (CSA). For example, MNP engages with ERS’s EcoRangers, who help manage the rotational grazing systems in the local communities. MNP specifically functions as an exit strategy once natural resource management projects have been completed to ensure that areas cleared of invasive wattle are continuously and effectively managed as rangelands.

Project Goals

While MNP’s program has successfully provided local mobile auctions and established local grazing associations, there is little evidence of strong female and youth involvement in these initiatives. Since older men are traditionally the owners of cattle, it was assumed that they were the main group benefitting from access to mobile auctions. Our project aims to understand the involvement of women and youth in this program and identify ways in which their participation can be improved. In order to unpack the underlying factors that play a role in women and youth participation (or lack thereof), we established three sub-goals: 1) analyze pre-existing datasets, 2) conduct individual and group interviews in the villages of Colana and Mzongwana to analyze the community-level impact of this program, and 3) create products such as infographics that our partners can use after our departure to promote this program. In order to tackle these goals, we analyzed three pre-collected data sets from auctions dating from 2014-2018. We then supplemented these findings with the qualitative data from interviews in Colana and Mzongwana. These steps were taken to understand why women and youth involvement is comparably low to that of men, and what barriers to entry these traditionally marginalized groups might face. This report will better inform future interventions by MNP.

SUMMARY OF ACTIVITIES CONDUCTED WITH LOCAL PARTNERS

Following the introduction of the projects, we met with our UCPP leads and local support from MNP: Mme Sissie Matela, Gerbrand Nel, Paul, and Bongie, with whom we would be engaging

with throughout the duration of the project. During our discussion, Mme Sissie explained that while the MNP program appears to be developing a viable source of income for local communities, there was an overall desire among UCPP and MNP leaders to understand who is actually benefitting from the program. They asked us to provide infograms and succinct fact sheets that would support the development of future programs. Additionally, they asked us to analyze existing data that had been collected during auctions from 2014-2018, which Gerbrand provided.

At first it was difficult to narrow the scope of our project because each leader had different questions about the program that they wanted us to answer. Gerbrand asked the team to understand the level of local interest in the introduction of a formal wool market at the mobile auctions, which he hypothesized could be an intervention aimed at increasing women and youth involvement. Mme Sissie wanted to understand the role of women in financial decision-making and overall autonomy. Lastly, Nicky McLeod asked us to investigate the overall financial impact of the auctions on local communities, with a specific focus on statistics related to the number of jobs created. Due to the multi-faceted nature of these requests, and their relevance to understanding women and youth participation in MNP's program, we initially struggled to identify the scope of our project. However, we soon realized that we could simultaneously gather information on women/youth participation and finances, as women's decision-making power in the household may be understood through a financial lens.

The local leaders provided us with ample information to develop questions. With a focus on women and youth participation, we drafted questions that centered around their involvement and experiences with MNP and the grazing associations. Our questionnaire included perceived benefits of access to auctions, membership in grazing associations, household power dynamics, and financial decision-making in order to understand if MNP is accounting for cultural and social barriers that may impact participation. We balanced qualitative and quantitative questions in our individual questionnaires so that we could analyze the data in an Excel spreadsheet without losing the more detailed personal narrative.

The next day we consulted with Paul and Bongie at ERS regarding the clarity of our questions, as that became a major concern for us when we were writing the questionnaire. They were able to help us understand how to best phrase and preface our questions so that people would be comfortable expressing their views. Additionally, Bongie listed six specific focus group categories that we could interview separately in Colana. We also were informed that we would have the opportunity to interview the chief of Colana, and so we developed a short set of questions regarding his view of the impact of auctions and the MNP.

After solidifying our questionnaire, we spent the rest of our time at ERS examining the data spreadsheets provided for us to gain an understanding of the auctions' demographics and financial statistics. There were four datasets with which we could generate potentially useful graphics that the UCPP had yet to analyze. The sheer amount of information was initially overwhelming because much of the information we sought to answer in our interviews already existed in some form, but we had to reorganize the information in order to determine the relevant findings. We spent most of our time sifting through the data and creating graphs that we felt might help us to answer our questions. During our time analyzing the available data, we also established a list of other potentially useful graphics from our interviews that could help inform gaps in our understanding of the pre-collected data.

The next day we conducted our interviews in Colana, organized by Bongie who acted as our guide and interpreter. She organized a community gathering for us to collect focus group data.

However, when we arrived we realized that we had to consolidate the categories of our focus groups from six to two, since there were not many women or youth present. Following the focus group survey, we conducted individual interviews with several women, which provided us with our first data set. At the end of our work in this first site, we realized that we should modify a few of our questions to improve our survey. Not only were there several questions that were ultimately irrelevant to our research, but we also needed to add multiple questions in order to collect data that was currently absent from our findings. Through this process, we managed to narrow the focus and scope of our project.

At Mzongwana, our second research site, Nnate Mkize organized a community gathering where we completed seventeen additional interviews with individuals from a diverse range of demographics. At the outset of the project, we did not anticipate interviewing any men; however, we had to broaden our data collection because six of the 17 interviewees at Mzongwana were men who had sold at the mobile auctions. We conducted a total of 21 interviews, with a majority of our interview data coming from Mzongwana.

For the next few days, we analyzed interview data for general trends and sentiments within the targeted groups. We also sought to connect findings from our pre-collected data sets with the results of our interviews to help complete the picture of the impact of mobile auctions on these communities. Finally, we analyzed the complete findings to create our infographics and presentation.

SUMMARY OF FINDINGS

We categorized our findings into three main sections: Gender, Age, and Finances. These findings draw from both the pre-collected data provided to us by Gerbrand and ERS, as well as the interview data we collected in Colana and Mzongwana.

1. Gender

Clearly, **far more male livestock owners sell in mobile auctions than female livestock owners** (see Figure 1). However, during the summer (Dec-Mar), which is the peak season for selling cattle, women's participation in auctions did increase. Meanwhile, during the winter (Jun-Aug), women do not sell at auctions nearly as much as their male counterparts do. This result suggests that female livestock owners may not sell frequently during the winter, whereas men are more likely to continue selling throughout this season. We think that this could be attributed to the fact that men rely on auctions as a primary source of income throughout the year while women do not; further research is needed to confirm this theory. On the other hand, the number of male sellers over time is increasing more rapidly than the number of female sellers, which seems to be stagnating. We recommend that MNP investigate this widening gap.

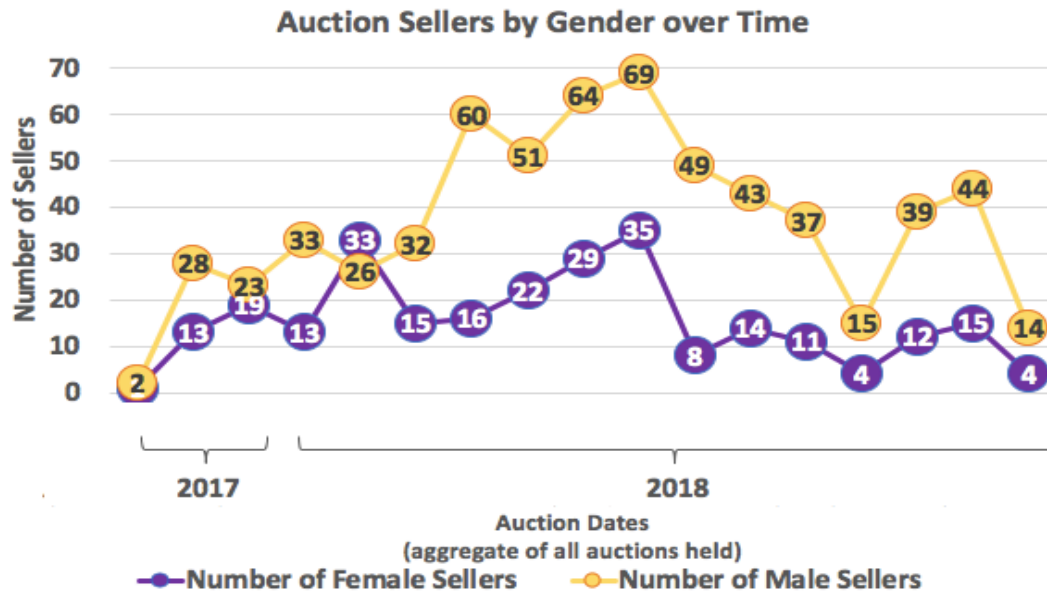


Figure 1

While this lack of increasing participation may be attributed to the idea that women might not earn as much money at the auctions as men, we found this to be untrue; **women actually earn almost equal profits to that of men** (see Figure 2).

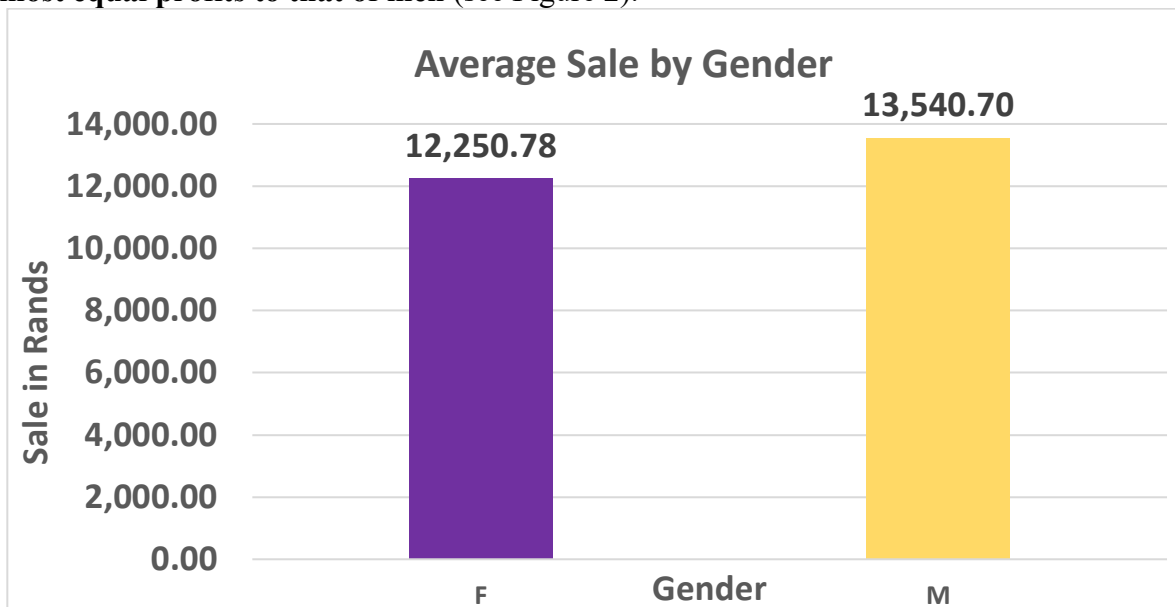


Figure 2

We hypothesize that women's lack of involvement could be attributed to the fact that women are not traditionally the heads of their households. Most of the women that we interviewed were not the heads of their households and did not sell at auctions. The fact that the only two female interviewees whom had sold at auctions were the heads of their households suggests that selling at auctions is reserved for heads of households only. Upon further investigation, we confirmed this finding – in both Colana and Mzongwana, interviewees explicitly stated that it is the responsibility of the head of the household to bring cattle to the auctions. This finding explains the lack of women's involvement in the auctions.

However, five of the six male sellers in Mzongwana said that they consult their wives and family before selling at the auctions. This indicates that **women may have indirect decision-making power in the outcome of the auctions**, and that they are not completely left out of decision making.

Another key finding was that **women do not tend to own more small stock than men** (see Figure 3), which disproves our initial assumption that small stock was a gendered livelihood. In fact, it was men that owned more sheep and goats than women across communities in Matatiele. This finding has implications for future interventions for small stock owners. Gerbrand has proposed a mobile shearing auction program that would allow small stock owners, particularly women, to sell wool locally. This program would provide shearing services and a formal market for wool. However, our findings suggest that because women do not own more small stock than men, any initiative surrounding small stock is not suited for a gendered intervention.

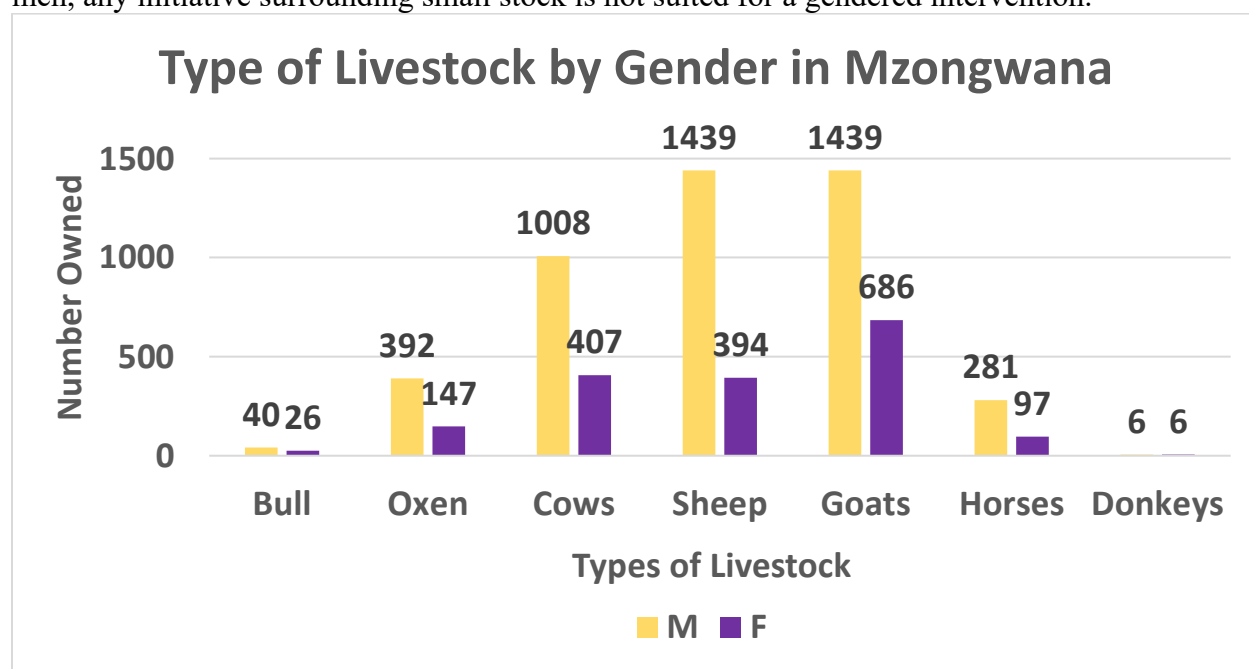


Figure 3

2. Age

Overall, there is **low youth participation in mobile auctions** (see Figure 4) based on data collected at auctions from 2014-2018.

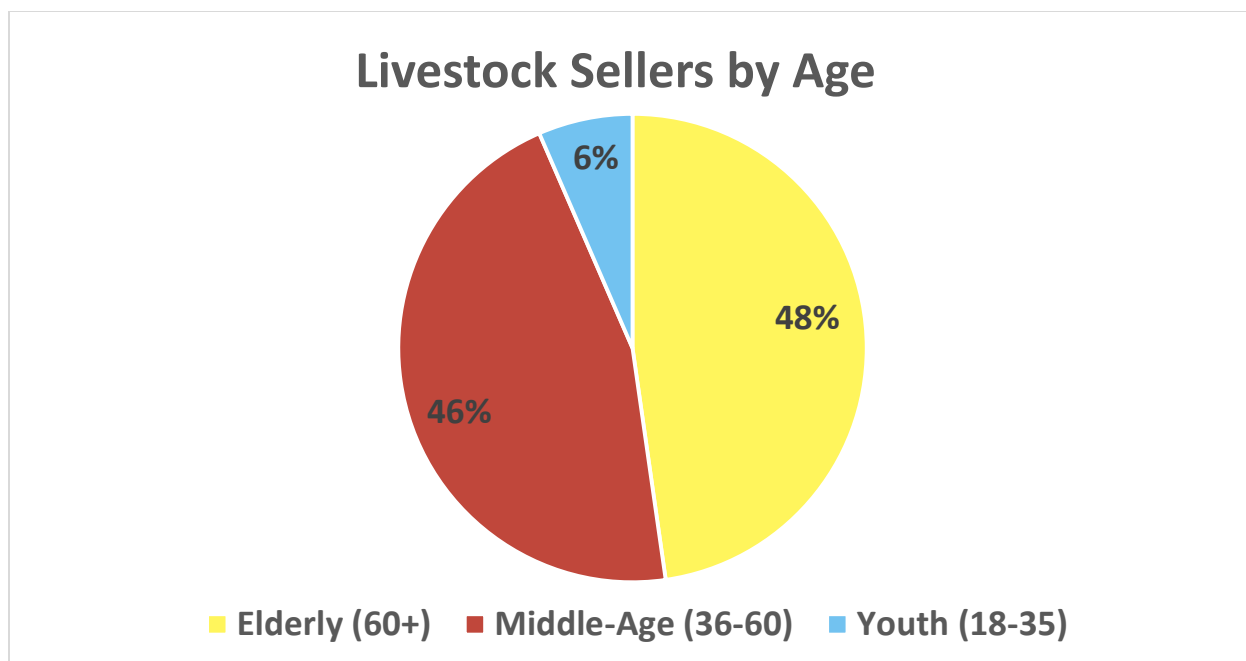


Figure 4

In Mzongwana we only spoke to male youths who owned cattle. Of this small group, 5 of the 7 individuals interviewed had sold at a mobile auction. However, the 2 youths who had not sold at auction did own sheep and were interested in the mobile shearing program. Due to the lack of a formal market, the two young men were receiving unfairly low prices for their wool. Thus, even though the mobile shearing program was initially suggested as a gender-related intervention, it may be better suited for engaging male youth.

Despite this, anecdotal evidence suggests that there is an underlying issue of youth moving away to large cities like Cape Town and Johannesburg after matriculation to find job opportunities instead of remaining at home to pursue livestock cultivation. Any intervention geared towards youth involvement must consider this phenomenon. Furthermore, the small group of youth that we spoke to represents a very small subset of the larger youth population of Mzongwana. Further research is needed to determine the full extent of this issue.

3. Finances

When analyzing general auction trends from 2014-2018, we found that Average R/Kg has increased over time and the total turnover (revenue made at auctions) has increased over time as well. **This indicates that livestock owners are earning more money per cattle over time** (see Figures 5 and 6), which may be attributed to increased trust in the mobile auction market, increased demand for cattle reared on sustainably managed rangelands, increased participation in mobile auctions, and/or healthier cattle as a result of increased vaccinations.

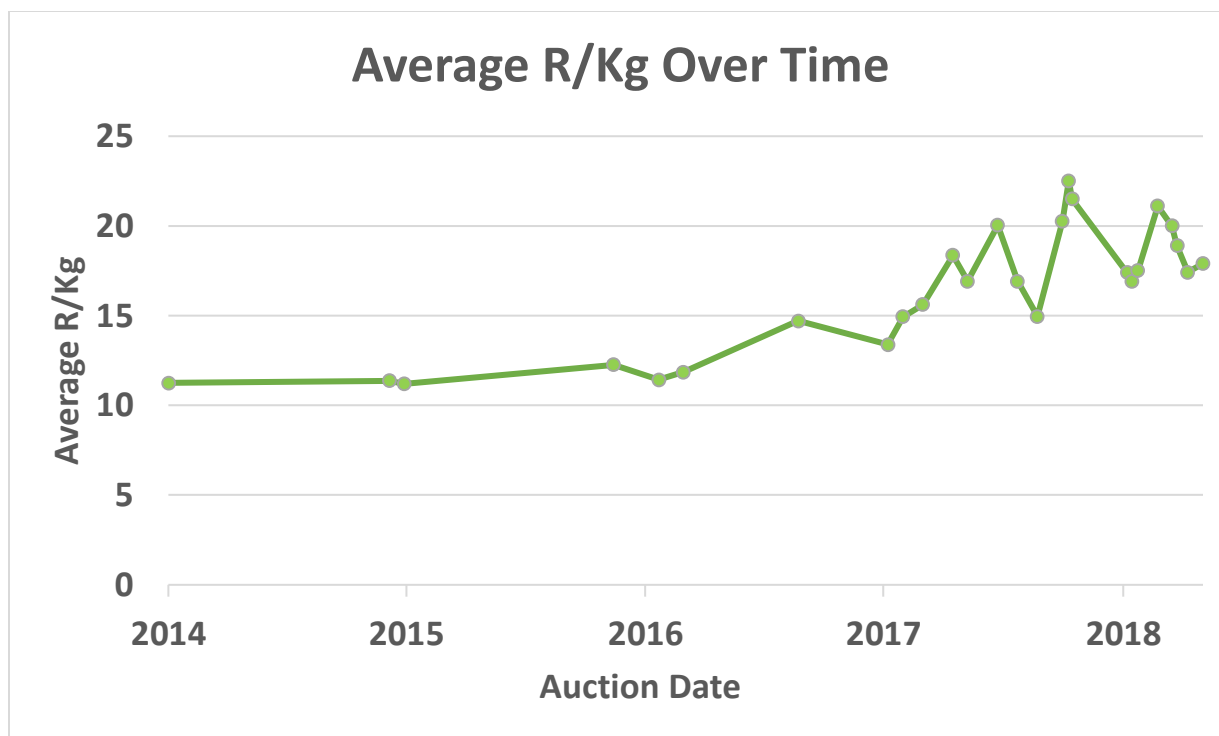


Figure 5

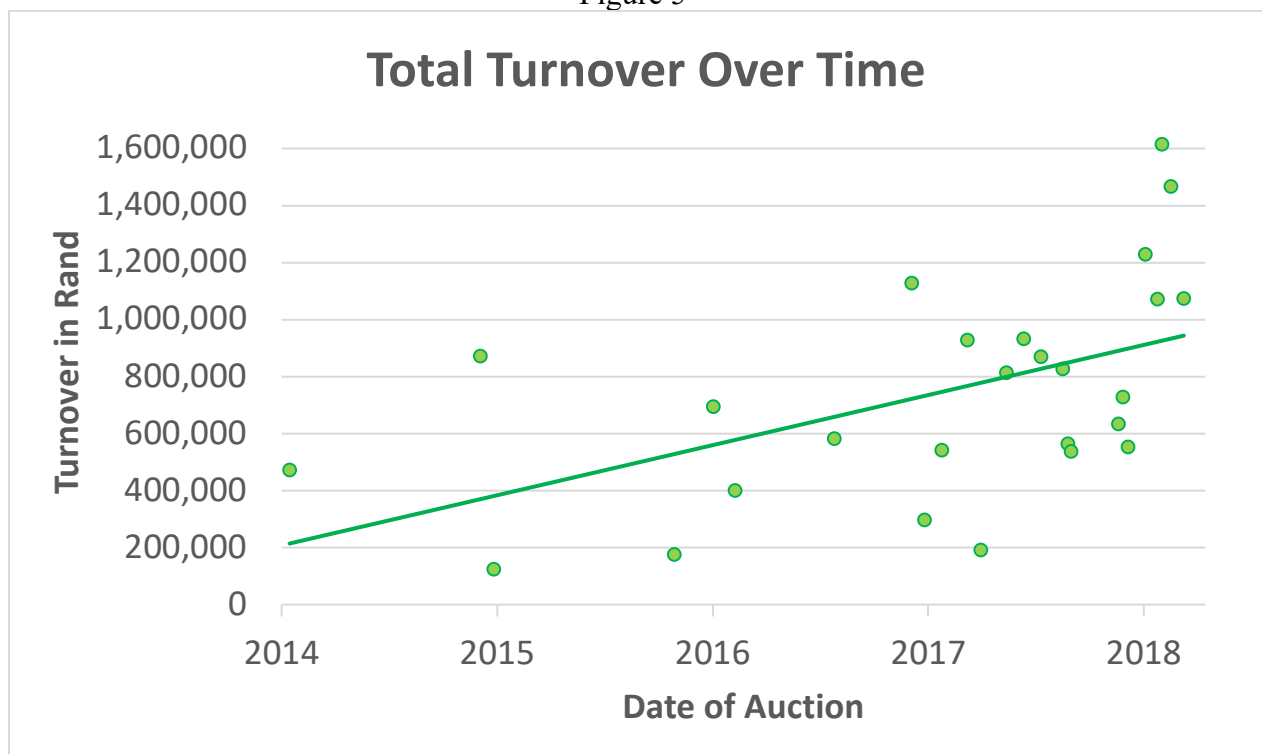


Figure 6

Our interviews with local livestock owners further illuminated the monetary benefits that community members receive by having access to mobile auctions. In both Colana and Mzongwana, sellers at auctions mentioned the benefits of having auctions in close proximity: for example, traveling from Mzongwana to auctions in Cedarville causes cattle to lose weight, and

so establishing mobile auctions eliminates this issue. In turn, cattle are now fatter at the time of selling and their profits have increased. **Not only are livestock owners earning more per cattle over time, but they are also earning more than they would at distant auctions.**

Additionally, livestock owners in Mzongwana described how **access to a local market allowed them to save money** since they did not have to hire transportation for their cattle to and from the auction.

However, because there is no formal wool market in Mzongwana or in Colana, **many small stock owners are not receiving fair prices for their goods.** In Mzongwana specifically, the price of wool varies greatly among each livestock owner (from ~R40 to ~R1500 per head). The majority of these sellers fall on the lower end of the spectrum, receiving marginal prices for their wool. Additionally, in Colana, only two of the four women interviewed sold wool informally: one woman sold wool for R100 per head and the other could not say for sure how much she earned. Since most sellers were not receiving a fair price for their wool, every respondent indicated that they were strongly interested in a mobile shearing auction.

CONCLUSION

Meat Naturally and the UCPP's data, in addition to the information we had the opportunity to collect in Colana and Mzongwana, has helped us better understand the impact of MNP in local communities. We are also now able to highlight areas of improvement that could advance the program in a positive direction. Overall, we found that women were not as excluded from the program as we initially believed. While there were far less women than men directly participating in the auctions, those that did were just as successful as men and based on our interview responses, still participated in the decision-making process with their husbands. Meat Naturally also believed they could increase women's participation in auction by including more small stock calls. However, we corrected this assumption by finding that men actually own more small stock than women. Our findings suggest that although this intervention may not be sufficient for engaging women, it could be used to engage local youth. Youth are similarly underrepresented at auctions. However, of the youth we spoke to, a majority expressed the desire to own livestock in the future. In this, if Meat Naturally continues implement new programs targeting youth involvement, there is great potential for the program to grow.

Lastly, while many aspects of MNP have proven successful, locals expressed several issues and barriers to full involvement in the auction program that need further research and intervention.

1. Communication

There is a lack of clear communication regarding the role of MNP in assisting livestock owners with the costs of branding, which is mandatory for livestock to have at auctions. As we understand, this rule was implemented to discourage the sale of stolen livestock. However, responses from the focus groups and interviews in Colana suggest that people are unaware of the advantages that membership in the grazing association provides, including subsidies on branding and tagging. This same issue occurred with livestock vaccinations, which community members feel is important livestock. MNP must find better ways to disseminate information to local communities because members want to comply with MNP standards.

2. Wattle

The community members in Colana also expressed their concern with the impact of wattle on livestock grazing. As wattle continues to encroach on resting grasslands, livestock owners noticed that cattle are unable to gain weight due to lack of available rangeland. Managing wattle

has been an ongoing battle, and we understand that solving this issue will not be easy. MNP can help address this issue by working in conjunction with wattle clearing teams to manage wattle growth on rangelands.

3. Further Research

In order to more fully understand youth livestock ownership, we believe that further research is required to document the types of livestock owned by different age groups. This realization comes from the fact that we did not have the data required to understand whether or not age influences livestock ownership. We found that a few youths in Mzongwana were interested in owning small stock, but more information must be gathered to flesh out the livestock ownership tendencies within each age group. By identifying trends, MNP will be better-equipped to design interventions that specifically target youths.

Overall, the progress made by MNP thus far is promising, as we have seen the benefits of mobile auctions in rural communities. Community members are enthusiastic about the program and are optimistic about its growth. However, there is still room for improvement when it comes to women and youth involvement. We hope that the information we gathered during this project will help Meat Naturally develop more targeted initiatives in the future.

UCPP Monitoring and Evaluation Framework Report

By Anela Arifi, Anna Whitney, Sherralyn Sneezer, Vignesh Chockalingam

INTRODUCTION

The UCPP, or uMzimvubu Catchment Partnership Programme, is a voluntary alliance comprising several non-governmental organizations (NGOs), the Department of Environmental Affairs (DEA) and Working for Water (WfW), the Alfred Nzo District Municipality, grazing associations, and local community members. The stated mission of the UCPP is to “Restore Livelihoods to Restore Landscapes.” Employing strategies including wattle removal, grazeland management, community education, and spring restoration, the UCPP seeks to restore and maintain the catchment ecosystem while supporting economic development, job creation, and the flow of ecosystem goods and services into local communities.

The UCPP faces a myriad of biophysical issues, including rampant wattle invasion, high erosion rates, diminishing grassland biodiversity, and water depletion. The UCPP mission is to clear invasives, combat erosion, restore grassland productivity, and improve water security, as outlined in the most recent 5-Year Strategy Plan. However, the UCPP partners have not maintained consistent, rigorous monitoring and evaluation to determine the impact of organizational interventions. Using effective monitoring and evaluating is effective in fostering donor and community support, re-aligning objectives, and improving organizational approaches. Our group set out to understand and evaluate the UCPP’s current M&E practices, and offer suggestions for how the UCPP can improve M&E in the short and long-term.

GOALS

In the past week, our group (Sherralyn, Anna, Vignesh, and Anela) partnered with Environmental and Rural Solutions (ERS), Meat Naturally PTY, and Conservation South Africa (CSA) to create a monitoring and evaluation (M&E) framework for the purpose of demonstrating a quantifiable impact of UCPP interventions. Focusing on the biophysical outputs, outcomes, and impact of the organization, the students worked with Aimee Ginsburg, our South African coordinator; Ashley Rainer of ERS; Clearing Team 4 of WfW; Gerbrand Nel of ERS/Meat Naturally PTY; Mme Sissie of ERS; Mzi of Conservation South Africa; Nicki McLeod of ERS; nTate mBuks of Motseng; nTate mKeze of ERS & Mzongwana; nTate Zuma of Working for Water (WfW); Preya of Mzongwana; and Yonela of ERS to understand current institutional and monitoring practices and develop a strategic action plan for the future.

Our overarching goal was to understand if the UCPP is gathering sufficient and appropriate evidence towards showing a change in ecosystem and livestock health as a result of the Landscape & Livelihoods (L&L) efforts. This goal was broken down into five individual tasks, upon discussion with our UCPP and local partners. The identified goals were the following:

1. Understand the theory of change and apply theory to current and future ERS practices
2. Identify current monitoring and evaluation practices and spatial/temporal spread
3. Condense all current M&E practices by ERS, CSA, and other entities in a spreadsheet
4. Identify gaps and opportunities for further M&E
5. Estimate an ecological production function
6. Create an M&E framework for the UCPP

In order to attain these goals, we created a Theory of Change infographic to incorporate the multi-faceted components of the ERS' Five-Year Strategic Plan in order to represent the information in an accessible manner. This infographic was created to guide future M&E practices so that they are in-line with stated organizational goals. Next, we scoured ERS records, analyzed GIS data, and communicated with CSA and the Alfred Nzo District Municipality to obtain a holistic picture of current M&E practices across the district. These data points are available in an attached spreadsheet. Data analysis figured into our efforts to identify gaps within the current M&E practices, as our analysis showed that the current data collection practices are not sufficient in providing definitive evidence of grassland rehabilitation. Additionally, we searched peer-reviewed literature and spoke with author and scientist David Le Maitre to create a production function in Excel that quantifiably delineates the relationship between alien invasive species removal efforts and the resulting increases in incremental streamflow. Finally, we crafted an M&E framework using our acquired knowledge of the Landscape and Livelihoods (L&L) program to address how M&E may be conducted moving forward.

Our efforts encompassed the whole of ERS, Meat Naturally PTY, and CSA activities, from wattle removal to grassland management to spring rehabilitation. We were strongly influenced by the theory of change, the ideas surrounding the provision of ecosystem services (such as Landscape Characterization Units (LCU's)), and the integration of traditional ecological knowledge from local community members in our research and the building of our framework.

ACTIVITIES AND PROCESS

Understanding 'Landscapes & Livelihoods' Monitoring Practices

We began our process at the inception meeting, meeting with Nicki McLeod and several CSA representatives to gain a more holistic picture of the task at hand. After identifying some preliminary goals, we began our research by reading the peer-reviewed articles provided and conducting informal interviews with members of the ERS and CSA staff. The following day, we went to the ERS office to discuss more with Nicki about what she hoped to see from our work and to learn more about the concept of ecosystem goods and services as defined by the UCPP. Yonela presented the concept of Land Use Characterization Units (LCU's) and described the biophysical processes in the landscape we would have to contend with in the creation of our framework. Next, we outlined all of the variables ERS was hoping to monitor and the methods they possessed to measure them on a whiteboard, coming up with a preliminary framework. After discussing the framework a bit further, and identifying the overarching goal as "...communicating the value of [ERS's] interventions on the ground," we left for Mzongwana.

In Mzongwana, we examined the sites that had been cleared of wattle and the subsequent grass recovery. In some areas, the grass had recovered well, in terms of both basal cover and biodiversity, but in other locations, the ground was still bare and hard (not conducive to grass growth of any kind). We learned more about the methods of wattle-clearing, including tree removal, ring-barking, and occasional herbicide use. We also learned more about the flow of the removed wood in the ecosystem and local communities; in cleared sites that are readily available to the community, women often come to collect the downed trees for firewood, while in other areas, they use the sticks and branches to create small dam-like structures to slow erosion and runoff. In learning about these interventions, we recognized the ingenuity and holistic nature of ERS' actions. We noticed that the ERS (and majority of the UCPP) works hard to integrate local

peoples and traditional ecological knowledge (TEK) into their conservationist projects. The organization also works to support local livelihoods in striving towards their mission, such as leaving the wattle behind for the local peoples to collect and facilitating employment in regions with little economic opportunity. Interviewing nTate Keze further solidified our initial

On Wednesday, our group joined ERS members to learn about their “citizen-science” monitoring methods in the field. We followed Nicki, Ash, Yonela, Mzi, and other partners as they demonstrated the basal cover monitoring methods (“Magic Square”), checked the soak pits in the wetland, and took a transect using the Disc Pasture Meter (“DPM”). In the riparian area, we helped perform a Mini-SASS evaluation, checking the microinvertebrate population, clarity of the river water, and streamflow volume. We felt that these monitoring methods were relatively comprehensive in terms of the ecosystem services the ERS hopes to measure, but we had to analyze the existing data to determine if the organization was achieving their monitoring goals (i.e. building a holistic, up-to-date picture of the trends in the ecosystem following ERS interventions).

Upon looking through the provided data files, we found that current monitoring records were not consistently sufficient to establish the direct impact of UCPP interventions on ecosystem health, specifically due to lack of controlled study and irregular monitoring. The lack of sufficient data is reflected in the Current Monitoring and Evaluation Practices spreadsheet that we compiled, using data provided by ERS, CSA, and the Alfred Nzo District Municipality.

Analyzing Data to Evaluate Impact of Resting Intervention

Despite the lack of data across ERS’ interventions, we sought to understand how ERS could turn monitoring into evaluation of its interventions. Therefore, we looked to the data to find an intervention whose impact we could evaluate through data analysis. Using a VELD assessment spreadsheet of six land transects in Mzongwana, our group identified, compiled, and analyzed data in Stata to compare the outcomes and growth of rested and unrested, open grazing grasslands across three distinct collection periods and two monitoring sites. This analysis relates heavily to ERS’ hope to improve grassland productivity through grazing associations, which rely on the assumption that resting grasslands will improve their productivity, which can in part be operationalized as biomass availability. Data from the veld assessment tracked disc pasture measure, DPM, which measures biomass at individual points. At each site in each of June, October, and January, 100 points were measured through DPM. After performing multivariate regressions with controls for time and time interactions, we found that unrested lands experiences greater grassland growth and biomass outcomes in the final monitored month, showing the opposite effect of what ERS’ hopes to achieve. Appendix _____ shows a flowchart overviewing our data analysis process. We will further expand on this analysis, our findings, interpretations of our results, and how our results must inform future UCPP monitoring and evaluation efforts, specifically in the context of controlled studies.

Process of Estimating the Ecological Production Function

While conducting interviews with the ERS and the CSA staff, we identified the need to mathematically estimate ecological production functions in order to link actions performed by the organizations with their biophysical impacts. This quantification would, in our opinion and as proposed by the staff, generate social and financial support by communities and the donors. To demonstrate the power of estimating ecological production functions, we used the example of estimating the impact of removing wattle by the ERS on water replenishment. We then reviewed

numerous peer-reviewed articles provided by the ERS and available in online databases in order to determine the feasibility of our idea and make sure we find a suitable mathematical equation for the calculation. This step proved to be successful as we found equations put forth in the DC Le Maitre, Versfeld, and Chapman (2000) article, “The impact of invading alien plants on surface water resources in South Africa: A preliminary assessment.” suitable for estimating water replenishment. This ‘suitability’ was determined based on matching the monitoring data the ERS possessed with the variables the equations requested. However, after some initial review of the equations, we realized there were some gaps in our understanding of the functions. These included lack of understanding of links and transitions between different equations. We also needed to know the average age and canopy cover of wattle trees in the area where the ERS has been working in order to perform our calculations.

In order to close these gaps, we spoke with Ntate Mkiza, Ashley Rainer, Nicky McLeod and David Me Maitre to get estimates of the age and canopy cover of the wattle tree, and understand the links between different equations in the aforementioned paper. The conversations and the email exchanges with Le Maitre helped us bridge the gaps in our knowledge and successfully craft a “Wattle-Water Replenishment Ecological Production Function” in an Excel spreadsheet calculator form. To help initiate the process of estimating other ecological production functions useful for demonstrating impacts of the organizations’ work, we created a flowchart detailing our steps toward making the estimation. We hope that this function will be helpful for planning future wattle removal work.

M&E Framework and Action Plan

Following the success with our function, we continued with our process of information-gathering and preliminary framework creation. In the ERS office, we spoke with Mzi, Mme Sissie, and Gerbrand Nel about their respective roles, aspirations for the UCPP, and desires for a monitoring framework. Integrating their responses into our collected information about the UCPP, we began the iterative process of M&E Framework and Action Plan. Our group went through multiple drafts and revisions of our framework using our knowledge of monitoring practices and the ERS’ Five-Year Strategic Plan. Our M&E framework includes the Impact, Outcomes, and Outputs of the UCPP’s interventions, with the Statement, Indicators, and Sources of Evidence for each. We included a Target column to prompt further interorganizational discussion about quantifiable targets they would like to achieve in the near future. The Action Plan include recommendations for the frequency and type of monitoring which should be undertaken in the future, on varying temporal scales. Additionally, our group put together a pyramid-style infogram as a visual aid to help with understanding the “Theory of Change” and how this theory interacts with the goals of the organizations. Finally, we created several flowcharts detailing our thought processes in the making of our deliverables. We feel that this was an extremely thought-provoking and iterative process, and we hope that our group successfully accomplished our stated goals in the eyes of the UCPP.

SUMMARY OF RESULTS

Through research into current monitoring and evaluation methods across organizations, we compiled a spreadsheet with the data provided to us detailing all the monitoring actions and interventions conducted by the ERS, CSA, and Alfred Nzo District Municipality for the past

several years. We acknowledge that this spreadsheet is only as cohesive as the data that was provided to us, and encourage the UCPP organizations to continue filling in monitoring data into the sheet as they collect it. An example of several rows of the spreadsheet and the key for column names:

Landscape Element	Measure	Methods	Measurer	Where	Data Quality	Regularity	# Sites	Spatial Data
Water	Sediment load	Turbidity tube	ERS	Mzongwana	Moderate (no organized system of data entry, some spreadsheet analysis within Mini-SASS data)	Irregularly (06/2015, 07/2016, 01/2017, 05/2017, 01/2018)	4 to 5	Unclear
Water	Riparian ecosystem health	Invertebrate analysis	ERS	Mzongwana	Moderate (no organized system of data entry, some spreadsheet analysis within Mini-SASS data)	Irregularly (06/2015, 07/2016, 01/2017, 05/2017, 01/2018)	4 to 5	Unclear
Water	Quantity	Flow volume	ERS	Mzongwana	Moderate (no organized system of data entry, some spreadsheet analysis within Mini-SASS data)	Irregularly (06/2015, 07/2016, 01/2017, 05/2017, 01/2018)	4 to 5	Unclear
Water	Temperature	On-site thermometer	ERS	Mzongwana	Moderate (some spreadsheet analysis)	Irregularly (06/2015, 07/2016, 01/2017, 05/2017, 01/2018)	4 to 5	Unclear
Water	Temperature	On-site thermometer	Alfred Nzo District Municipality	Unclear (latitude/longitude data is available but municipality would have to provide it)	Good (available from District Municipality)	Monthly	Unknown	Unclear

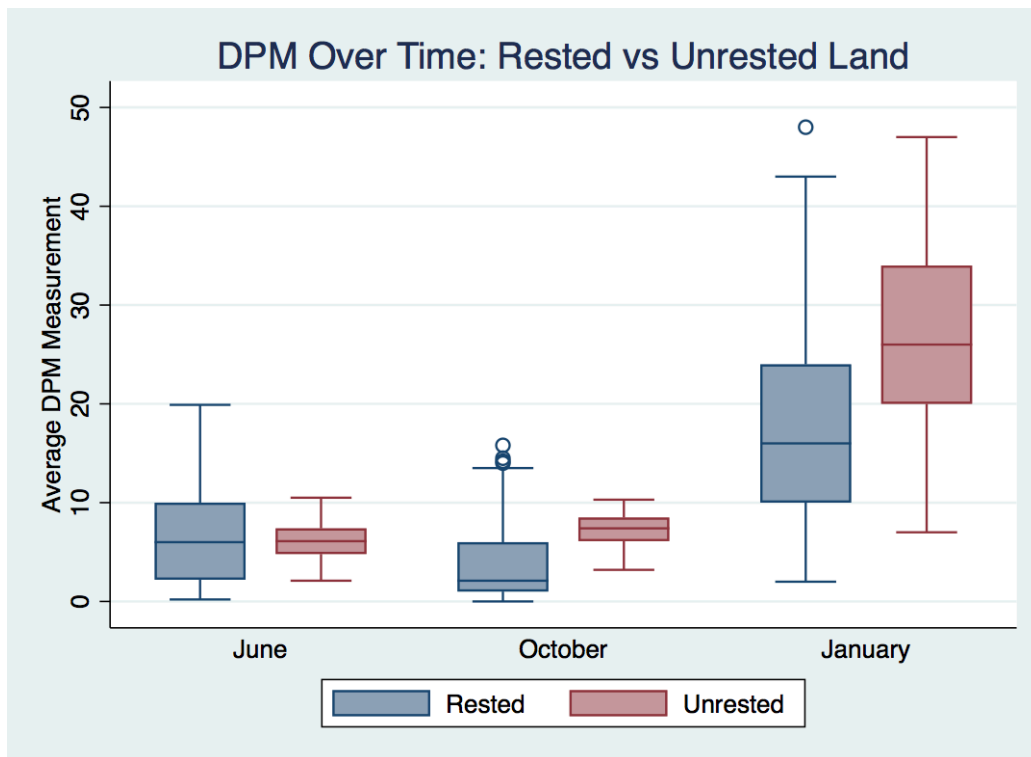
Name	Description
Landscape Element	Portion of the landscape being observed or measured.
Measure	Indicator for ecosystem health or rehabilitation being measured.
Methods	Citizen-science method used.
Measurer	Which organization is performing the monitoring action.
Where	Where in the region monitoring for a certain measure taking place.
Data Quality	None available, Poor, Moderate, Good. Determination of quality of current monitoring practices.
Regularity	How often monitoring is taking place.
Spatial Data	Y/N/Unclear. Availability of GIS mapping for specific monitoring actions.

We ran a Stata statistical analysis in order to discern if the current collection methods were producing viable data to prove the organizational thesis of the UCPP. Using a veld assessment data collection spreadsheet, our group compared rested versus unrested lands and the subsequent effects on grass biomass of these designations (according to the “Disc Pasture Meter” measurements).

Findings of Rested Land Stata Analysis

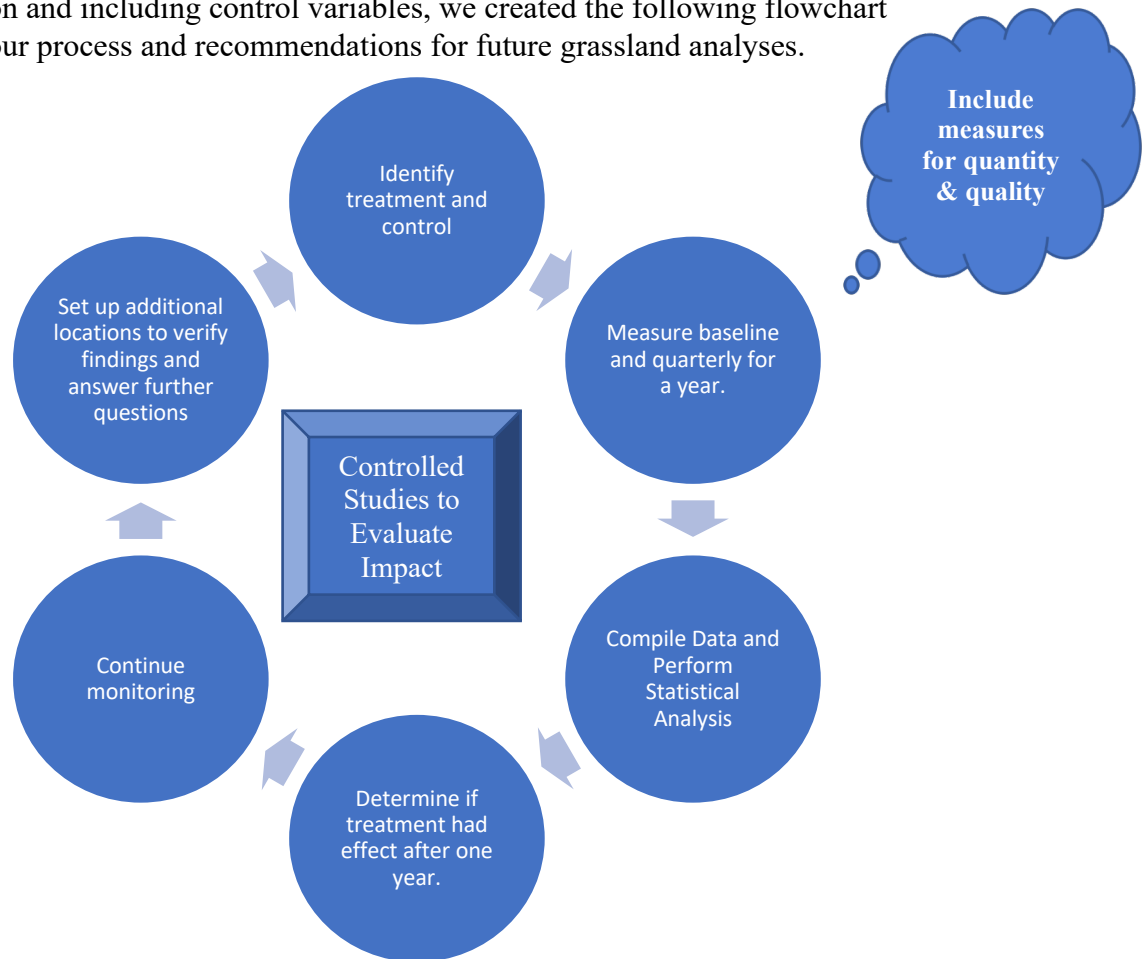
Our analysis in Stata revealed that unrested lands in the dataset experienced greater growth and outcomes in biomass than rested lands, contrary to the ERS’ aspired impact. The below regression table summarizes the findings of three regression models. The first model, a regression of DPM on a binary variable for resting (Rested =1, Unrested=0), shows the difference in DPM outcomes between rested and unrested lands. The second model adds a control for time, ensuring that the effect of time does not confound effect results. The third model adds a time-rest interaction variable, which allows us to assess the difference in DPM with time - in essence growth over the three months.

Given the first and second regression, rested lands perform worse in DPM measures than unrested lands. Specifically, controlling for time, rested lands on average have a 4.165 cm lower DPM reading than unrested lands - revealing that rested lands have lower biomass outcomes than unrested lands. In the third model, adding a time-rest interaction reveals that rested lands experienced lower growth across the monitoring period than open grazing lands. In fact, the difference in average growth across time was 5.056 cm in DPM reading. The below box plot displays our two main findings: rested lands on average experience worse biomass outcomes than open grazing lands, and rested lands experience less growth in biomass over time.



In addition to supporting the findings of our regression, the above graph also reveals some potentially confounding variation in data collection. Across all three monitoring periods, the rested land DPM measurement has a greater range and more outliers. This may be due to uncontrolled differences in transects across the two sites, human error in data collection, the relatively small sample size, or a number of other potential confounding reasons. Moreover, the results may be biased because of flaws in the monitoring method: DPM is very reliant on humans, and therefore suffers from human error. In addition, the data does not account for confounding differences between the sites, such as elevation, soil types, and water access. While such confounding factors exist, the findings may also indicate some practical failures in UCPP theory. For example, factors including land bioturbation or varied livestock and community reactions to rested lands may skew biomass growth and outcomes. Additional analysis that corrects for problems in sample size, monitoring methods, and data collection is needed to further explore these questions and evaluate the impact of resting land. We will discuss this further in our report.

In order to provide direction on potential future analyses of grasslands, starting with a research question and including control variables, we created the following flowchart demonstrating our process and recommendations for future grassland analyses.



We recommend that the UCPP conduct more controlled studies to evaluate their impact in the future. To facilitate this process, we created another flowchart demonstrating how to conduct a controlled study, along with some potential future research questions as a starting point. These research questions include “Is wattle removal replenishing water and encouraging growth of grasslands?” and “Are grasslands healthier in areas with grazing associations?” This flowchart and potential steps towards answering our research questions are available in Appendix A of this report.

We also developed the “Wattle-Water Replenishment Ecological Production Function,” which links the UCPP’s efforts towards wattle removal with water replenishment based on the best available peer-reviewed literature and advice from a published author on this topic. In order to present the function in an easily accessible and use-oriented manner, we created a spreadsheet calculator which needs only the approximate age of the stand and number of hectares cleared to produce the output of total water replenishment in both meters cubed and liters. We hope the

UCPP utilizes this production function to quantify the biophysical impact of their efforts. An example of the ecological production function spreadsheet calculator in action follows:

Age of Stand (years)	Number Hectares Cleared (ha)	Canopy Cover	Condensed Area of Hectares Cleared	Aboveground Biomass (g/m ²)	Streamflow Reduction from Invasion of Alien Trees (mm)	Conversion from mm to m ³ /ha	Total Water Replenishment (m ³ or kiloliters)	Paper Amount	Factor Difference
10	1242.26	50%	621.13	12940	307.972	3079.72	1912906.484		
10		50%	68493	12940	307.972	3079.72	210939262	2.17E+08	1.02873215

The process by which we created our ecological production function is illustrated in Appendix B. This chart can be used for future efforts to delineate relationships between biophysical factors in a production function format.

Additionally, in an effort to connect the UCPP's efforts with broader sustainability goals, we create an infographic demonstrating how each of the UCPP's actions may contribute to the Sustainable Development Goals (SDGs) put forth in 2014 by the United Nations. We identified parallels between the UCPP's interventions and the following SDGs: 2 (Zero Hunger), 5 (Gender Equality), 6 (Clean Water and Sanitation), 8 (Decent Work and Economic Growth), 9 (Industry, Innovation, and Infrastructure), 10 (Reduced Inequalities), 12 (Responsible Consumption and Production), 13 (Climate Action), and 15 ('Life on Land'). The figure describing how these parallels are drawn is available in Appendix C of this report.

Finally, our M&E framework and Theory of Change infogram are available in Appendix D and Appendix E of this report, respectively. We synthesized the information we had collected through interviews, literature review, discussions, and ERS document searches to produce an M&E framework for future use by all organizations in the UCPP. Finally, with the help of the ERS 5-Year Strategic Plan and our own M&E framework, we created an infogram describing how the inputs, actors, actions, outputs, and outcomes work synergistically to culminate in the achievement of the UCPP's overall impact, defined in the mission statement included in "Introduction."

REFLECTION: GAPS AND RECOMMENDATIONS

Our group found this process to be enjoyable and enlightening in terms of how the organizations within the UCPP should move forward with monitoring. Through our research, we identified four areas within the monitoring and evaluation umbrella that hold potential for improvement. These improvement areas are encapsulated by the following titles: "Measurable Objectives," "Monitoring & Collecting Data," "Analysis & Application," and "Capacity Building." Within each subset, we have identified several ways in which the organizations could potentially improve their practices. Though the current M&E efforts are admirable, these improvements could allow for a more persuasive and data-driven "proof of concept" of the organizations' interventions and ultimately help demonstrate a measurable impact to all interested parties. In addition to these specific recommendations, we hope that the UCPP will utilize our M&E Framework and Action Plan (Appendix D and attached spreadsheet) in order to derive a holistic picture of the landscape and interventions taking place within it.

In terms of "Measurable Objectives," we recommend setting specific, quantifiable targets to establish a clear direction for future interventions. We believe that these targets should be set in a democratic format, integrating comments from all members of the organizations within the UCPP. Using this suggestions as a foundation, the UCPP (or organizations within the UCPP,

such as ERS) should develop quantifiable targets for their outputs, outcomes, and impact to guide long-term organizational objectives. This iterative process should inform the creation of a new organizational 5-Year Strategy Plan.

In terms of “Monitoring & Collecting Data,” collecting data regularly and consistently is all-important, so that trends data collected can be analyzed effectively and in a manner that produces statistically significant results. When reporting collection methods, it is important to explain the significance of the indicators. Measuring variables that you know you will use. Managing data records fastidiously. “Record-keeping in field sets the standard for further use of data.” Asking, does current M&E generate data that will be need to assess impact? Is the data comparable over time in the same testing site. Fastidiously record methods used for data collection and share among all monitoring organizations. Surveys among collecting bodies and identify areas for further research/studies.

In order to achieve the “Analysis & Application” goals, all organizations undertaking monitoring must address the lack of controlled on-site studies. To achieve comprehensive M&E, monitors must set a baseline at each new monitoring site (suggested steps of which are included in our attached monitoring plan). These data points and pictures should be securely recorded in a spreadsheet, perhaps labeled “Controls.” From our analysis of the current monitoring data, we determined that there is not enough baseline information about individual sites to perform analysis with significant results (that may be directionally positive for the organization). Additionally, controlled study can help the UCPP in evaluating the impact of their interventions. From interviews with stakeholders, we have found that the UCPP seeks to show that its interventions are creating the impact they desire. In situations where this impact is specific, such as quantifying grass regrowth, experimental setups comparing a treatment group to a control group over time can identify the effect of interventions. There are many immediate areas in which the UCPP would benefit from implementing controlled study to evaluate the impact of interventions. For example, in a controlled study among two plots, one where wattle was recently removed and one where wattle remains, the UCPP can measure grassland biomass, basal cover, and species composition, water inundation, and streamflow, consistently across a year. The results of this study would show if wattle removal replenishes water and encourages grass regrowth over time. Such study will provide more meaningful, rigorous evidence for the impact of interventions than observational evidence, which we encountered often in interviews with stakeholders. Our recommendation for the use of controlled study to evaluate the impact of different interventions again underscores the need for more consistent monitoring and use of collected data to evaluate impact.

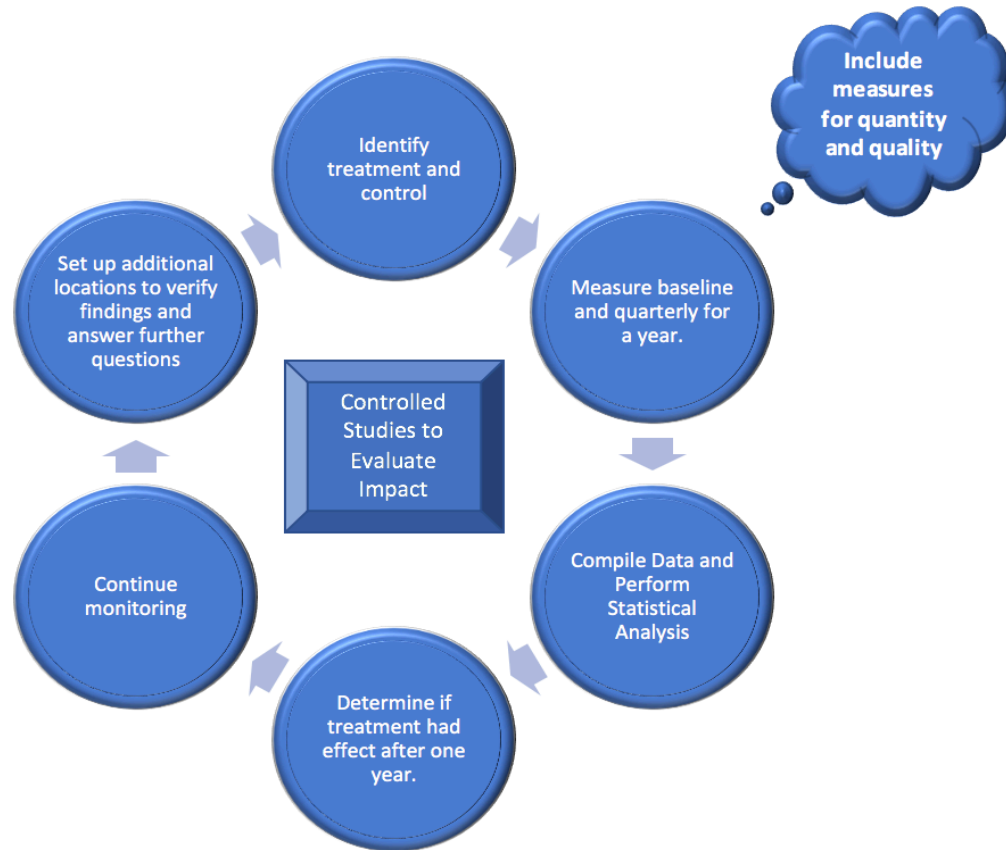
Finally, in terms of “Capacity Building, our group recommends including more citizen-science monitoring in order to facilitate capacity-building. We often heard that the “lack of warm bodies” to perform monitoring was a major issue, and we believe “putting the ‘citizen’ in citizen-science” could help alleviate this issue. In order to achieve this, we recommend ramping up community education about the organization’s work. We observed the importance of community engagement throughout this project, such as nTate Keze’s daily rainfall observations in more remote areas. Community engagement is a main pillar in successful conservationist projects, and the traditional ecological knowledge that may come along with community engagement is invaluable to information-gathering and strategy. We independently brainstormed ways in which UCPP could integrate community members and their stores of knowledge of the landscape, and our group settled on creating an app to make it easy for on-site local monitors to send in information. To our delight, Ashley Rainier of ERS had already started beta-testing an app very

similar to the one we had thought of. An important variable that we had not taken into account in our own discussion of using technology to involve the local peoples had been the lack of literacy in many regions with interventions. Fortunately, Ash had thought of this, and his app is mainly visual cues to take pictures of areas with interventions that send to a main database. We strongly recommend further development of this app to integrate communities in your mission.

We are optimistic about the potential for M&E to illustrate the widespread positive influence of the UCPP on ‘Landscapes and Livelihoods’ in this region. Linking the organization’s actions to biophysical trends has the ability to generate social and financial support, both of which are necessary in the mission of any organization.

Appendices

Appendix A



Other Potential Areas to Use Controlled Studies

- Is wattle removal replenishing water and encouraging the regrowth of grass?
 - A controlled study among two plots, one with wattle removed and one with wattle remaining. At different points of time, measure grassland biomass, basal cover, and species composition, and trends in water inundation and stream flow. Identify if wattle removal is improving water replenishment and grassland restoration.
- Are grasslands healthier in locations with grazing associations?
 - A controlled study among different types of locations – those where grazing associations are in place and those where there are not. Measure grassland indicators to understand vegetation quantity and quality at both locations. Identify if grassland associations are improving grassland productivity and resilience?

Figure detailing the process by which the UCPP can perform controlled monitoring studies.

Appendix B

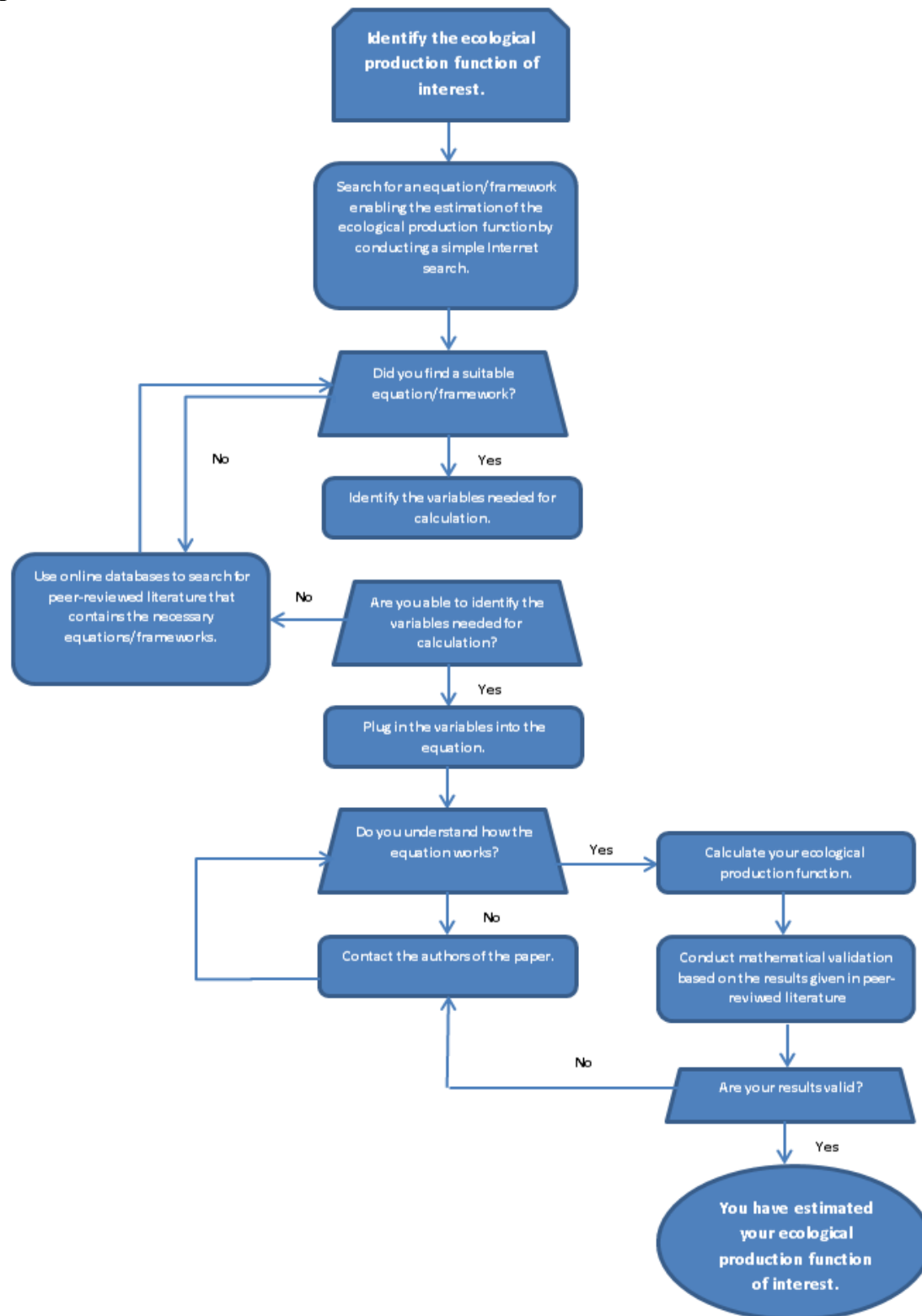


Figure detailing the process by which the UCPP can estimate an ecological production function.

Appendix C



Appendix D

uMzimvu Catchment Strategic M&E Framework				
	Statement	Indicators	Sources of Evidence	Targets
<i>Impact</i>	Sustainable restoration and maintenance of the catchment area to support economic development and job creation for local people.	<ul style="list-style-type: none"> Hectares restored and maintained. Improved ecosystem services. Economic impact and job creation. 	<ul style="list-style-type: none"> Achievement of outcomes 	
<i>Outcomes</i>	Productive grazing landscapes.	<ul style="list-style-type: none"> Cattle health measurements on-farm and at auction 	<ul style="list-style-type: none"> Cattle mass, fertility & mortality rates 	
	Increased biodiversity.	<ul style="list-style-type: none"> Increased resilience of grassland ecosystems to climatic events and disease Re-growth of grassland indigenous species Improved carbon sequestration in grasslands 	<ul style="list-style-type: none"> Indigenous ecological knowledge Observations of spatial and temporal trends 	
	Clean, abundant water.	<ul style="list-style-type: none"> Restored, functioning springs with ready access for local peoples and animals Potability of available water supplies in communities 	<ul style="list-style-type: none"> CSA restoration records Community anecdotes 	
	Reduced soil erosion.	<ul style="list-style-type: none"> Increased agricultural productivity on farms Increased water quality for human and animal consumption 	<ul style="list-style-type: none"> Agricultural outputs Observations of spatial and temporal trends 	
<i>Outputs</i>	Alien invasive removal.	<ul style="list-style-type: none"> Hectares cleared of wattle in priority areas Biomass of alien species/hectare in designated cleared areas 	<ul style="list-style-type: none"> GIS modelling Record-keeping Wattle-water replenishment ecological production function 	
	Improved vegetation quantity.	<ul style="list-style-type: none"> % basal cover improvements over time. Increase in grass biomass. 	<ul style="list-style-type: none"> Disc Pasture Measure "Magic Square" cover analysis Veid assessment Fixed-point photography 	
	Improved vegetation quality.	<ul style="list-style-type: none"> Species composition in grasslands Ratio of species present (diversity index) in grasslands 	<ul style="list-style-type: none"> "Magic Square" cover analysis Veid assessment Fixed-point photography 	
	Surface water replenishment.	<ul style="list-style-type: none"> Increased incremental streamflow in riparian areas Increased wetland inundation 	<ul style="list-style-type: none"> Wattle-water replenishment ecological production function Soak-pit measures On-site streamflow volume Observations of spatial and temporal trends 	
	Improved water quality.	<ul style="list-style-type: none"> Microinvertebrate species diversity in flowing water Chemical composition within potability range in flowing water Low sediment load in flowing water 	<ul style="list-style-type: none"> Mini-SASS Multi-point assessments Clarity tube 	
	Improved water infiltration and retention.	<ul style="list-style-type: none"> Decreased runoff from hillsides and cleared areas Improvement in soil properties so that more conducive to absorption 	<ul style="list-style-type: none"> Splashboards Soil sampling Observations of spatial and temporal trends 	

Figure: Monitoring and Evaluation Framework.

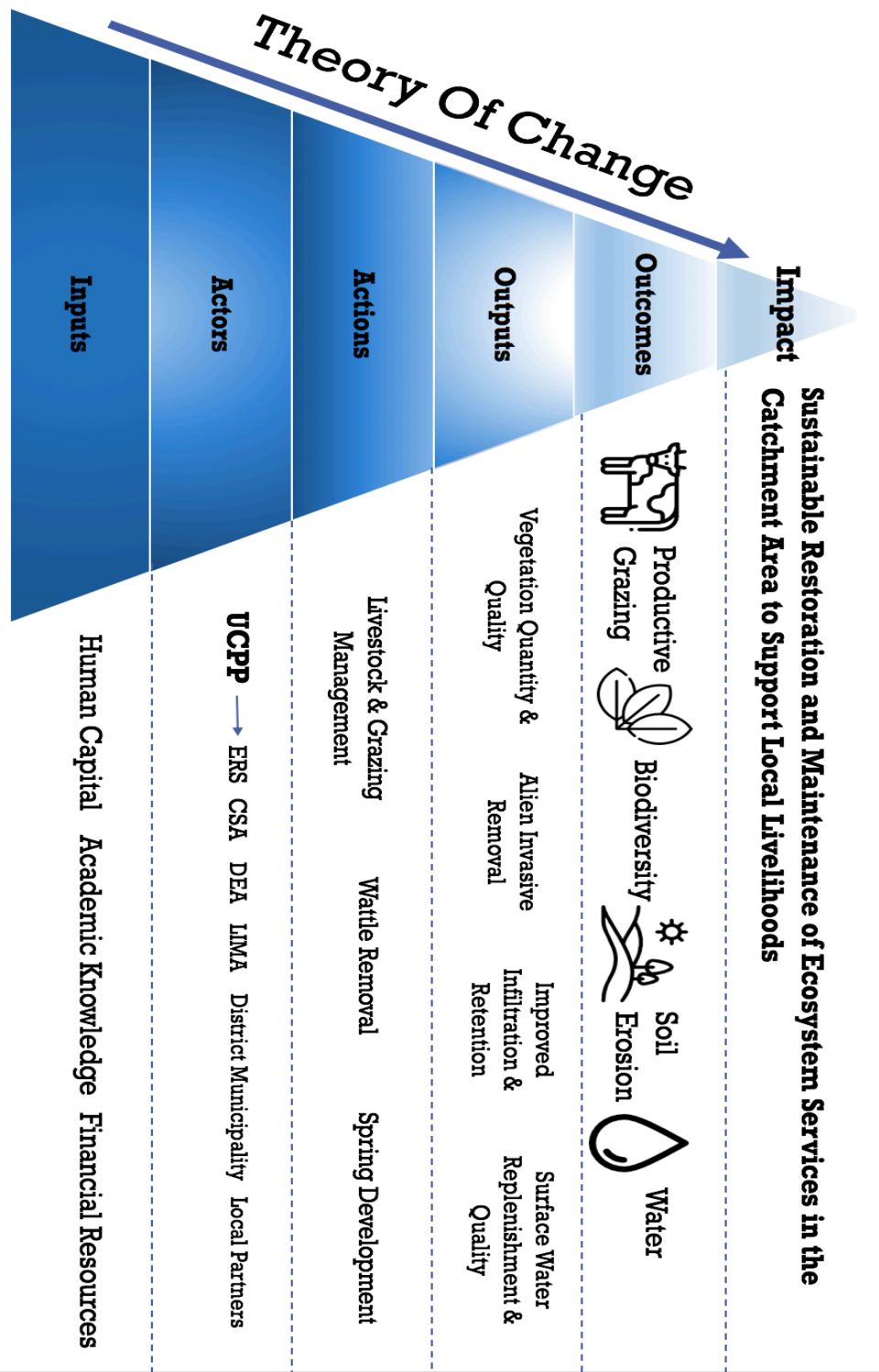


Figure: Theory of Change as related to UCCP Impact, Outcomes, Outputs, Actions, Actors, and Inputs.