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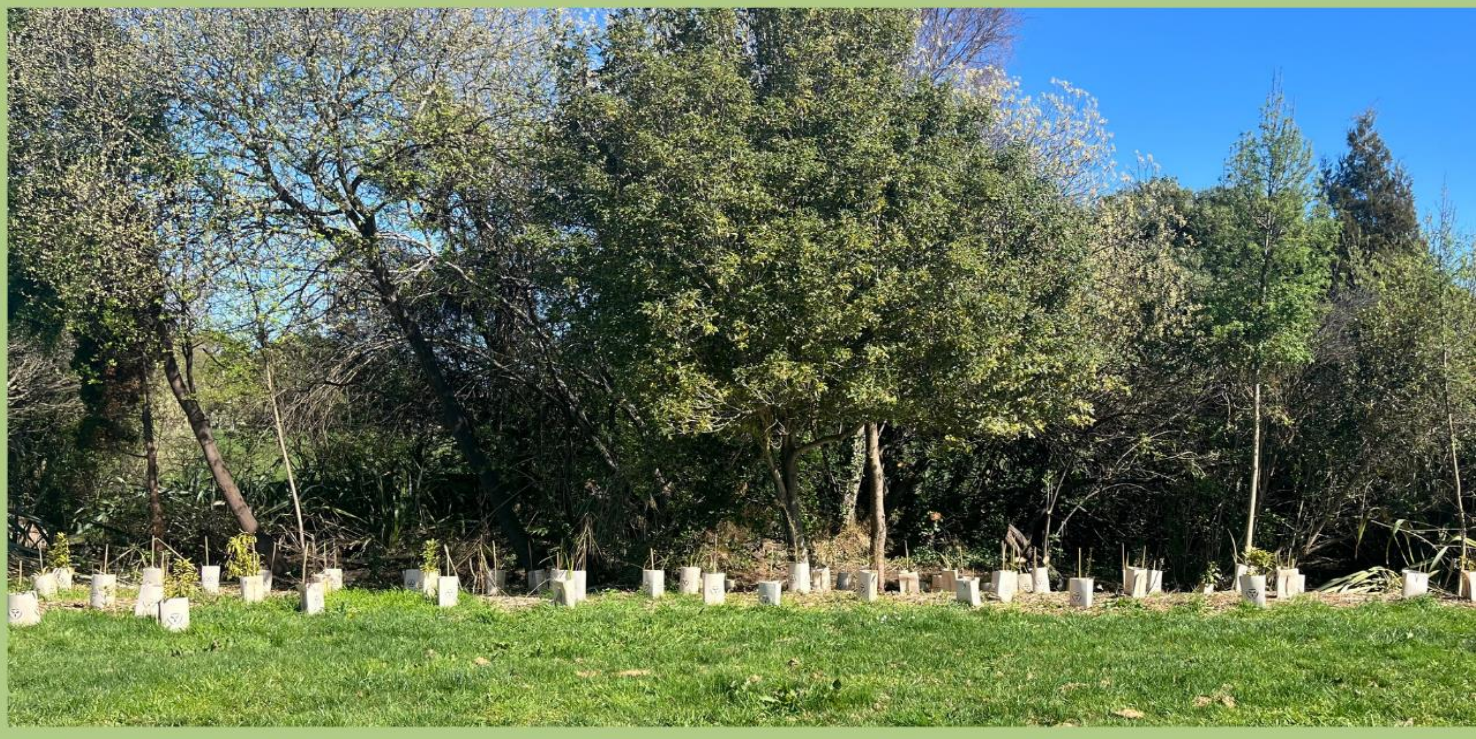
Pūharakekenui-Styx Living Laboratory Trust Community Tree Planting Scheme

To what extent was the Pūharakekenui-Styx Living Laboratory Trust community tree planting scheme successful and would it be beneficial to replicate at a broader scale?



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GEOG309: Research for Resilient Environments and Communities

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Executive Summary

This research project evaluated the success of the Styx Community tree planting scheme and its potential for canopy cover enhancement. The tree planting scheme delivered a native tree to 1020 properties in the Redwood area, hoping they would be planted. The objective is to investigate the effectiveness of distributing native trees to houses, gather insights into residents' attitudes towards the project, and the overall impact of the planting initiative. Through reviewing literature, surveying was found to be suitable for collecting data from our population and gathering useful information. The group collected surveys by face-to-face door knocking, posting to local community Facebook pages, and providing QR codes for people to complete the survey. This provided us with a 9% sample of the entire population. Our results show that 60.4% of the trees delivered were planted in the Redwood area in and around Murchison Park. We conclude that the Styx community tree planting scheme was a success as it met our threshold of 60% and the community's perspective of the scheme was generally positive as indicated by their high success ratings. Our recommendations would be to increase communication before any tree deliveries to residents and provide more accompanying information about the tree on delivery.

1. Introduction

In June 2023, The Pūharakekenui-Styx Living Laboratory Trust (SLLT) delivered 1020 native trees to properties around Murchison Park in Redwood, Christchurch. In partnership with Christchurch City Council (CCC) the SLLT wanted to determine the strength of driving a community scheme to increase urban tree canopy cover (UTCC). The Pūharakekenui SLLT was formed in 2002 and is a community organisation dedicated to creating a 'living laboratory' within the Pūharakekenui Styx river catchment. Committed staff, volunteers and trustees advocates for preserving the river by maintaining its recreational value, water quality, and ecological balance. They hope to ensure the river remains clean, healthy, biodiverse, and accessible 22 for future generations to appreciate. The native trees were delivered one late afternoon in June, with a pamphlet of instructive information and a gift certificate for trees for canterbury. Residents were given the option of meeting on a set date to plant their tree at Murchison Park or to plant their tree on their own property. They were given the choice to return their tree if they did not want to take part. The following report covers the processes and outcomes of this community tree planting scheme.

The primary goals for the project included enhancing UTCC coverage within the area, fostering community involvement, addressing climate change mitigation, and understanding residents' attitudes toward tree plant initiatives. This research addresses each of these, through topics such as local biodiversity and ecosystem health, community perspectives and engagement, and UTTC.

The main research question when researching this tree planting scheme was, 'To what extent was the Pūharakekenui-Styx Living Laboratory Trust community tree planting scheme successful and would it be beneficial to replicate at a broader scale?'. The success of the scheme was determined by whether the tree got planted and is still alive as of September 2023. The threshold used to establish the success of the 1020 trees was 60%, meaning if 60% of the trees that were delivered got planted, the project was deemed successful.

The following report first investigates the methods used in this research, then the results and finally the discussion, where a deeper analysis of the project and its outcomes are explored. This research

on the Styx community tree planting scheme is essential for SLLT to gain an understanding of whether their scheme was successful or not. This extensive information recovered can be used to increase the chances of future tree planting schemes being approved by CCC as well as allowing improvements for future projects. Therefore, it holds great importance to support the future of UTTC cover in Christchurch, hence supporting the city's efforts to fight climate change.

2. Background Literature

Research was undertaken regarding five different sub-themes that were deemed relevant to the Styx Living Laboratory Trust (SLLT) community tree planting scheme. Five individually written reports were formed with the purpose of providing a variety of further information to gain a better understanding of a wide range of components that this project encompasses. The chosen five sub-themes were; the effects of UTTC cover on the environment, the relationship between urban design and the physical environment, indigenous geography, community engagement and the relationship between urban tree UTTC and social vulnerability.

2.1 Environmental

Each report resulted in a significant variety of useful and reliable peer-reviewed research. After collating reports, a large array of environmental factors and concerns became apparent. The indigenous geography report brought to light mainly the connection between urban environments and indigenous flora and biodiversity. Findings established from these connections included how indigenous species thrive best with cover from taller vegetation as less isolation resulted in better growth and survival. These findings by Sullivan et al (2009) directly aligned with research found by Stewart et al (2004) who concluded the ideal environments for the successful attempt of indigenous vegetation restoration. Relating closely with the SLLT scheme, evidence has suggested that conservation gardening is certainly achievable in residential backyards (Segar et al, 2022).

Further environmental concepts were highlighted in the research report regarding the effects of UTTC on the environment. UTTC has been shown to substantially lower surface temperatures, therefore contributing to the reduction of UHI intensity (Loughner, 2012). Alongside this, a study

completed by Tallis et al. (2011) highlighted the significant contribution of urban trees in the removal of atmospheric particulate pollution from the air. So far, these two reports have shown that increasing UTCC can only have positive effects on environmental sustainability, if done appropriately. Danford et al. (2014) went even further on this, stating that inappropriate tree selection can disturb water consumption in dry climates and lead to minor human health problems or the risk of falling trees.

2.2 Social Cohesion

The community engagement reports provided us with further insights into a critical component of environmental decision making. More understanding into resident collaboration, social benefits of tree planting, the barriers in the participation of urban tree planting schemes and previous positive outcomes was needed. Austin (2002) found that financial constraints were a large factor in the lack of participation of low socio-economic areas within Detroit, USA. Additionally, McElwee and Nghi (2021) uncovered the participation challenges due to income inequality and lack of forest land allocation. Critically understanding demographics when undertaking a community-based project is integral as it further addresses the underrepresented demographics that may lead to unintentional bias. A coinciding factor is the relationships between individuals within the community. Austin (2002) found that the want to become more friendly with neighbours can be a driver in participation of community schemes and residents who changed their minds once observing neighbours' successes (Riedman et al, 2022).

2.3 Inter-connectivity

Meurk and Hall (2002) place further interest towards landscape and planning dimensions with their study, "Options for enhancing forest biodiversity across New Zealand's managed landscapes based on ecosystem modelling and spatial design". This was analysed within the report, further insighting the relationship between urban design and the physical environment but closely links with other research into indigenous flora and biodiversity, highlighting the importance between maintenance, restoration and sustainability.

The distributional equity of UTCC has increasingly become an important focus of studies by ecologists and social scientists, in particular, by Riley and Gardiner. If future initiatives were to be proposed, considering the relationship between the environmental and social impacts, alongside the effects of UTCC would likely benefit the efficiency and outcome (Riley & Gardiner, 2020). Research undertaken in the relationship between UTCC and social vulnerability report highlighted a combination of social, political and environmental factors. Landry et al (2020) discusses the evidence to suggest that increased canopy cover has been associated with positive ecosystem services and advantages, including mitigating air pollution and urban heat, which have additionally been linked to enhanced human health and overall well-being.

The research further uncovered previous or ongoing community schemes similar to the SLLT community tree planting scheme. McNamara et al. (2022) found that increased property value, aesthetic values and environmental benefits were most contributed to resident participation. The connectivity of a neighbourhood has been found to increase success through the social norms of surrounding residents and to additionally have positive ongoing social impacts throughout a community as De Guzman et al. (2018) discovered. Racial diversity and economic disadvantages have been found as a key component to the failure of tree planting schemes due to project leaders failing to align with residents, therefore lowering engagement.

This research has indicated that future studies should investigate and contrast the positive impacts of trees, associated costs, ecosystem services and challenges across urban areas situated across varying climatic regions. Understanding of community engagement is inhibited without insights into social motivations, barriers, demographics. This is crucial research for the project alongside human health risks, disparities, resulting environmental impacts and urban design.

3. Methods

3.1 Research Strategy

The research commenced with a planned research strategy to identify relevant literature and resources for the study. A general review of existing literature was conducted, following established guidelines for systematic literature reviews. This process involved exploring academic databases and peer-reviewed journals using specific keywords such as community engagement, UTCC, indigenous geographical area, and social vulnerability to refine the searches. This ensured the search criteria were well-defined and wide-reaching to capture the breadth of available knowledge and resources best aligned with the research goal (Roy et al., 2012).

3.2 Formulating Survey Questions

The project aimed to gather information regarding the individuals responsible for planting and receiving the trees, the resident's perceptions of the project, and feedback for future schemes. A human-centred approach was used in developing the survey questions to achieve this (Lohr et al., 2004). The questionnaire was drawn from the literature review insights. The survey questions were designed to align with the research objectives, and the capacity to yield informative responses. These questions were designed to understand residents' viewpoints concerning the community tree-planting project. Participants were asked open and closed-ended questions, yes/no questions such as; ‘Did you receive a tree from the Styx living laboratory?’ Then followed by multichoice questions and attitude-related inquiries rated on a four-point scale, offering response choices that spanned from 1 (indicating strong disagreement) to 4 (indicating strong agreement). Furthermore, pilot testing was carried out to refine the content of the questionnaires.

3.3 Data Collection

The data was acquired through the implementation of door-to-door surveys carried out in the Redwood areas as shown in Figure 1. The approach was purposefully opted instead of using mail or phone surveys, as studies in the field of public health have demonstrated their superior

effectiveness in boosting response rates, minimising bias, and fostering greater trust between interviewers and respondents (Moskell & Allred, 2013). We visited selected areas in small teams, knocking on doors and surveying participants. When no one was available at a household, a QR code for the survey and a note were left on their doorstep or letterbox. The survey was posted on the Redwood community Facebook page to extend the potential sample catchment of responses. The study's geographical domain was divided into five discrete sections around Murchison Park, as shown in figure one.

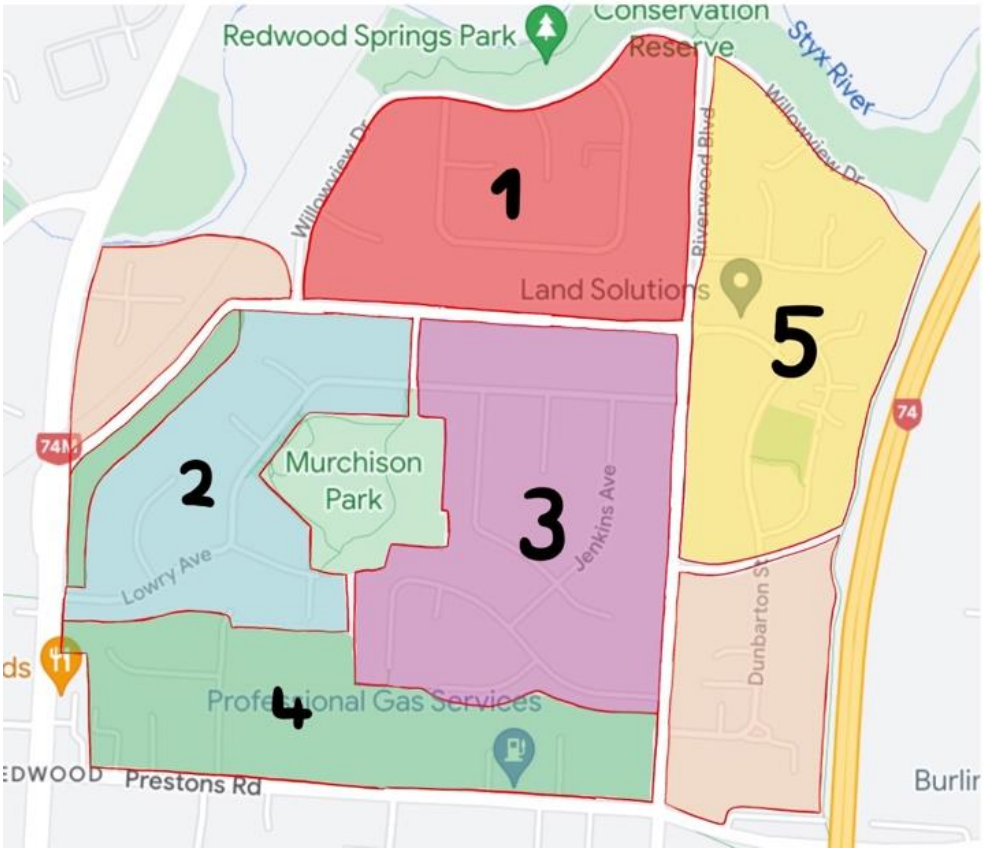

Figure 1:This map illustrates the geographical distribution of the survey sample area. The different coloured sections labelled 1-5 are what the SLLT used to distribute the trees. They were used to divide up the area for surveying.

The study aimed to interview 10% of the residents in the neighbourhood who received trees through the community tree planting scheme (approximately 102 households from the total 1020 where trees were delivered). This sample size was chosen to balance statistical significance and practical feasibility, providing us with valuable insights into the demographic of the beneficiaries and their sentiments regarding the program's effectiveness. Moreover, given the constraints of time

and the extensive geographical area to cover, a 10% sample size was considered a realistic approach to enable the collection of valuable insights within the available time frame. Furthermore, variety of research tools were used, including structured interviews with the Trust and the CCC and survey questionnaires to a sample of the households where trees were delivered. These were informative, allowing for additional information not captured in the Qualtrics dataset.

3.4 Data Analysis

In the data analysis process, the survey data initially obtained through Qualtrics was exported to an Excel spreadsheet. This dataset contained responses to the types of questions mentioned above. The central aim was to differentiate the tree recipients and acquire insights into their experiences and perceptions. Additionally, an analysis was conducted to evaluate the success rate of the tree-planting project. Specifically focused on whether the distributed trees were indeed planted and tracking the subsequent fate of these trees and the characteristics of those who did and did not plant.

4. Results

The results of the survey aimed to evaluate the success of this initiative. The analysis includes data related to the gender and age distribution of respondents, tree delivery and planting rates, perceptions of changes in local biodiversity and ecological health, community engagement and views, and potential factors influencing tree planting success.

From the study area, 92 survey responses were collected with a fairly even distribution over all sections and total area. The distribution is shown in Figure 2 below with each location point representing the approximate location of each survey conducted.

Figure 22: Shows the study area outlined in red. The green location points are the approximate location of every survey completed.

4.1 Gender and Age Distribution of Respondents

A total of 92 survey responses were collected from the sample area, comprising 45 male respondents and 47 female respondents. The nearly equal gender distribution is shown in Figure 3 below. This balanced gender distribution minimises the potential for gender-related bias in the findings. Notably, for male respondents, the age group of 30-39 was the most represented, while for female respondents, the age groups 40-49 and 50-59 was the most represented.

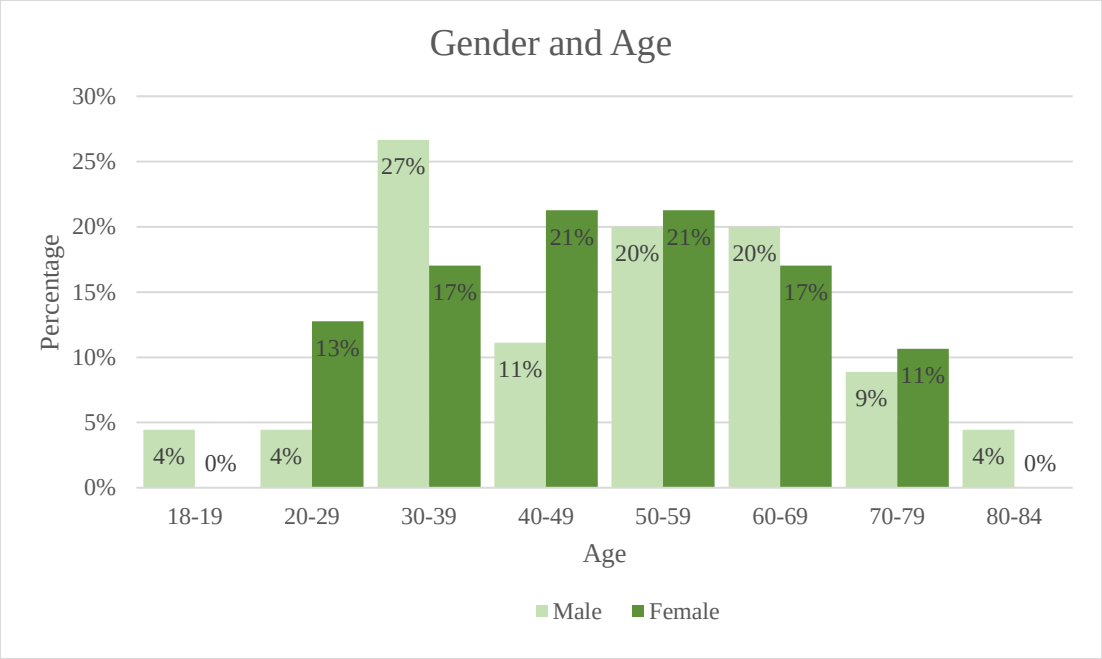

Figure 33: Shows Gender and Age distribution of the 92 survey respondents. The highest age range was 30-39 males which represent 27% of the total male respondents.

4.2 Tree Delivery and Planting Rates

In the sample area, 88% of the survey respondents received a tree, while 9% did not, and 3% were unsure (Table 1). The successful delivery rate was commendable, as trees were mostly left by letterboxes. For the "maybe" responses, there are various potential scenarios, including the possibility that someone else in the household planted the tree, the tree might have been discarded, or the recipient might still have the tree but not be aware of it. For the "no" responses, possible reasons included not living in the house at the time of delivery or being temporary tenants.

Table 1: The survey results for the question determining how many people did, did not or maybe received a tree. The count of each category is shown in the table as well as the percentage of the respondents.

Did you receive a tree from the Pūharakekenui-Styx Living Laboratory Trust?	**Count**	**Percentage**
Yes	81	88%
No	8	9%
Maybe	3	3%
Total	92	100%

Table 2 shows the fate of the trees received, out of the 81 trees that were delivered, 28 individuals planted them on their property, and 19 still have the tree but have not planted it yet. Only 10 respondents planted their tree at the community planting day. In total, 49 out of the 81 trees received were planted, while 26 have not been planted, but individuals still possess them, offering hope for future planting schemes. Only 6 respondents did not plant their tree and no longer have it. Figure 4, 5 and 6 show some examples of what happened to peoples trees. These have either been planted or yet to be planted. These results reflect a significant success in terms of tree delivery and initial planting.

Table 2: The results for the survey question asking what happened to the trees out of the 81 people that received one. The count and percentage of each category is shown in the table. In total 81 out of the 92 respondents received a tree.

What did you do with your tree?	**Count**	**Percentage**
Elsewhere	7	9%
Planted on the property of a friend, relation or neighbour in the area of Redwood north of Preston's Road?	11	14%
Have not planted the tree and no longer have it	6	7%
Have not planted the tree but still have it	19	23%
Planted at community planting day at Murchison Park	10	12%
Planted on own property	28	35%
Total	81	100%

Figures 4, 5 and 6: Shows trees in residents' properties, planted or yet to be planted on the day of surveying.

4.3 Perceptions of Changes in Local Biodiversity and Ecological Health

Responses to questions regarding noticeable changes in local biodiversity and ecological health were predominantly negative (Figure 7). This finding can be attributed to several factors, including the relatively short time frame since the tree planting scheme's initiation. Ecological changes, especially those related to biodiversity and ecosystem health, often require years or even decades to become evident. Another contributing factor could be a lack of awareness or knowledge among residents who may not regularly observe the area to detect any changes. Future assessments may provide more insight into this aspect as the scheme matures.

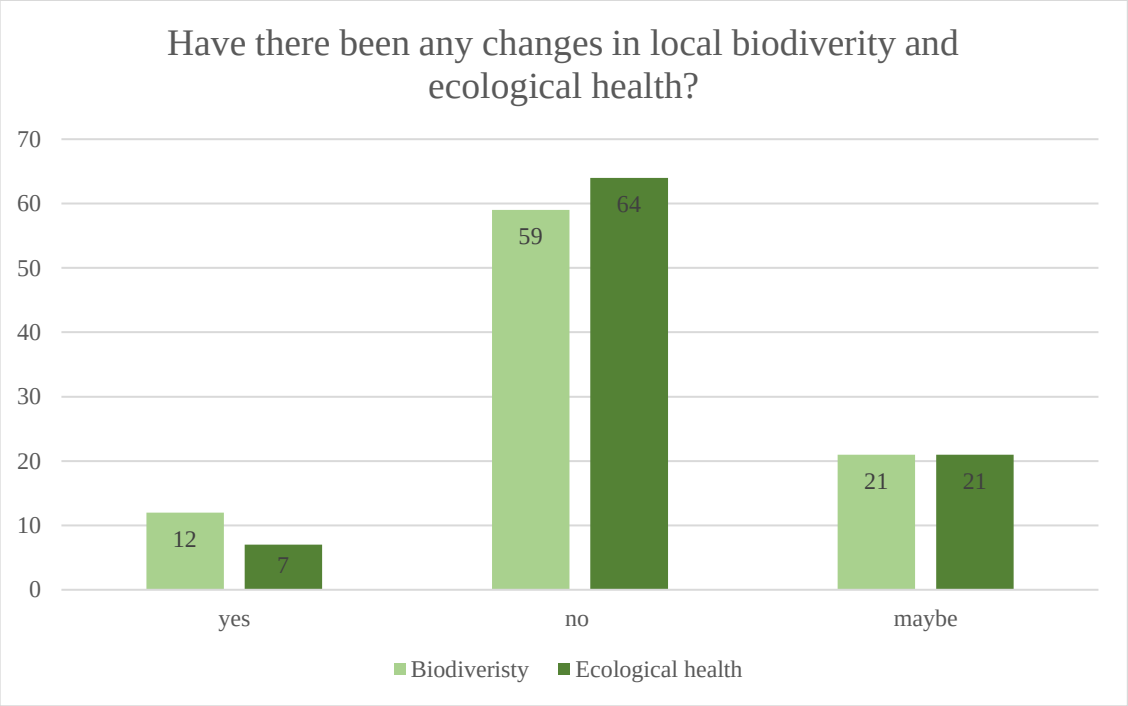

Figure 74: Shows results for the question asking if the survey respondents have noticed any changes in local biodiversity and ecological health since the scheme began. Most of the respondents replied no when asked if they noticed any changes.

4.4 Community Engagement and Views

The results in Table 3 reveal that the community's overall response to the Styx tree planting scheme was positive. From the comments received about the project, 69% of them expressed positive sentiments, while only 5% of comments were negative, with 26% being neutral.

Table 3: Shows the overall response to the SLLT tree planting scheme. 69% of people had a positive response while 5% of people had a negative response, and 26% of people had a neutral response.

Community response to SLLT tree planting scheme	**Percentage**
Positive	69%
Neutral	26%
Negative	5%

4.5 Recipient's challenges when dealing with their tree

The survey responses indicate that 69% of people had no challenges when dealing with their trees, while 18% faced challenges, and 13% offered no comment (Table 4). Most respondents had a positive experience, but a significant minority encountered issues when dealing with their trees. Challenges mainly revolved around identifying the tree species, determining suitable planting locations, understanding the tree's growth potential, and knowing how to care for it. Additionally, some trees lacked instructions and stickers, which may have fallen off after delivery.

Table 4: Shows the results relating to the survey questions asking if people had experienced any challenges when dealing with their tree.

People who experienced challenges when dealing with their tree	**Percentage**
No	69%
Yes	18%
No Comment	13%

4.6 Influence of Age and Gender on Tree Planting Success

The analysis between age and the likelihood people will plant their tree (Figure 8) reveals that people aged 35.5-70.5 are more likely to plant their tree while the likelihood that trees won't be planted is stronger for ages 27-74.75. The median for 'yes' responses is 10 years higher than the median for no responses. The range of people that that responded 'no' is wider than those that responded 'yes'.

Figure 85: Shows the likelihood of people planting their tree compared to age. The median for 'yes' respondents is 55.5 years old and the median for 'no' respondents is 45.5. Note that the age range has been averaged for this figure. For example, age range 20-29 has become 24.5.

4.7 Community Feedback Themes

Feedback from the community was diverse, but a few common themes emerged. Table 5 shows that the most prevalent comment was "keep it up" and general praise for the tree planting initiative. Additionally, residents expressed a desire to be notified in advance of tree drops, a wish for more information about the trees they would receive, and even the possibility of choosing their tree species.

Table 5: Shows the community feedback themes received through the survey and how often they occurred. The most common theme was 'keep it up/it was great' which occurred 20 times.

Community feedback themes	**Number of times this occurred**
Keep it up/ it was great	20
Prior warning/ communication in advance of tree drop	15
Seek interest and willingness of participation from residents first	4
Smaller trees for smaller properties	4
Name the trees	3

Consult more with community	3
More trees to more suburbs	2
Group planting	2
More information on the tree when received	2
Hand washing at community planting	1
Just give the voucher	1
Make contact with residence as it is delivered	1
It's a big physical commitment	1
Increasing flora and fauna coverage replace concrete	1
Provide fertiliser	1
Made people feel special/included	1
Talk about it in schools - educate kids	1
Type and size of tree should be more considered	1
Better instructions on what to do with the tree	1
More community planting sites	1
More vouchers/discounts for more trees	1

5. Discussion

5.1 Summary of Key Results

The Pūharakekenui SLLT wanted to know the success of their residential tree planting scheme and whether it was an effective way of increasing UTCC. The major findings were that 60.4% of the trees distributed were planted. Overall, the results suggested that the Pūharakekenui SLLT were successful in their methods of distributing trees, which would subsequently increase UTCC.

5.2 Interpretation

5.2.1 Age and Gender

The results revealed that age and gender of participants have a relationship contributing to the tree planting scheme. Females and males in the 50-59 age group were more likely to plant trees, while

males in the 30-39 age group were by far the least likely (Figure 3). Data collected primarily represents the 30-69 age bracket, with less data of the 18-19, 20-29, 70-79 and 80-84 age groups. This skewed representation may explain why 50-59 were the most likely to participate as they were one of the most consistent age groups to be surveyed. The same applies to males in the 30-39 age bracket, as they were the demographic with the highest representation in the survey. Therefore, these findings may be a result of the sample demographic.

McElwee and Nghi (2021) insist that gender and age play a significant role in engagement in tree planting schemes. Biernat & Piątkowska (2020) suggest that people aged 50-59, without parental responsibilities may have more time to themselves. This may account for this age groups high participation in the Styx Scheme, opposed to young parents and elderly. Conversely, males 30-39 may be the least likely to participate, due to busy times in their career and family responsibilities, as indicated by Manchester et al, (2018). These patterns of age and gender may be attributed to the sample demographics and the life stage-related time availability.

5.2.2 Trees received review

Table 1 demonstrates the success of the tree delivery scheme, with a 60.4% rate of trees planted. Some respondents reported not receiving trees, possibly due to safety concerns, others may not have been aware if someone else in their household planted the tree, and some properties like short-term rentals might not have had occupants during tree deliveries.

The 39.6% of trees not planted could have negative community impacts, as uneven tree distribution often results in socioeconomic disparities (Nylele & Kroll, 2020). Table 2 highlights a substantial number of residents who didn't participate in the project. Engaging with those who still possess but haven't planted their trees (23.5%) could raise the planting rate to 83.9%, offering significant potential for more planted trees, as supported by McElwee and Nghi (2021).

5.2.3 What happened to the trees?

Breaking down where the trees were planted, the most common planting location was on the residential property that the tree was delivered to (Table 2, Figures 4, 5 and 6) which suggests that

the method used by SLLT is relatively successful at distributing and planting trees. Having the community planting day occur in the days coming after the initial tree drop, acted as a backup to catch trees that residents did not want or know how to plant. The community planting potentially diverted 12.3% of the trees that may otherwise not have been planted. Notably, trees planted within the study area but not on their original property still indicate success as the trees were planted in the area. These trees will still contribute to the overall increase in canopy cover in the area.

5.2.4 Biodiversity and Ecological Health

The projects results expressed that most participants didn't notice any changes in biodiversity and ecological health from the tree drop off to the surveying (Figure 7). Several factors may explain this lack of change. The short 3-month timeframe between the plant drops and surveying was insufficient for the trees to grow noticeably, as some trees take between 2-10 years to fully grow (Trees down under, 2022). This delayed growth can make ecological health and biodiversity changes less apparent as they are reliant on tree growth and can take years to become noticeable (Li et al, 2023). Another explanatory factor may be the participants' lack of knowledge on biodiversity and ecological health, leading to confusion when commenting on local changes, particularly with riparian planting along the Styx River. Additionally, people may not be walking around the area, or taking notice of their surroundings. Between June to September, New Zealand is in Winter (Douglas et al, 2001), which may have limited outdoor activity, preventing people from noticing environmental changes.

5.2.5 Community Engagement and Views

The results revealed broad community views, spanning from positivity to negativity and offering valuable insights for future initiatives (Table 3). Positive feedback, comprising over 50% of responses, demonstrated strong community support and alignment with the project's goals. This positivity likely contributed to the 60.4% tree planting success. Table 2 indicated that some participants planted trees in their friends' or neighbours’ backyards, underlining the role of social connections in community tree planting efforts, as highlighted by Austin (2002). On the other hand, negative comments and reluctance to participate mainly stemmed from residents who didn't plant or receive trees. Some explicitly expressed disinterest in the project.

Most of the feedback provided constructive suggestions for improvement (Table 5). Recommendations included better communication before tree drop-offs, community involvement before events, and more information about tree drop days. This hints that the no-contact approach without prior communication might not have been the most effective. Other feedback focused on tree-specific details, such as size, type, and naming native trees. Additional comments emphasized the need for increased community consultation and more planting sites, suggesting that the community's needs could have been better prioritized in the scheme, as supported by Riedman et al. (2022). Participants acknowledged challenges associated with trees but generally deemed them insignificant and not sufficient to deter tree use in urban areas.

5.3 Implications

The implications of this study revolve around the success of tree planting initiatives and future projects. The findings can inform the characteristics of a community for successful schemes and guide in selecting an appropriate community with possibly higher ratios of a particular demographic. Residents Feedback collected in this study can inform and improve future projects, to enhance their success. Implementation of feedback on prior notification and information with trees on delivery may intensify Future project engagement.

5.4 Limitations

5.4.1 Response bias

While a significant number of survey responses were collected, there were some limitations. For safety reasons, some houses with gates were not entered, and QR codes were left at unoccupied houses, which affected the sample size. The goal of a 10% population sample was not achieved; instead, a 9% sample was used. The survey questions could have been more concise and clearer, as some respondents were unsure about the questions' intent.

5.4.2 Sampling/survey bias

The survey had nearly equal representation of genders, but certain age groups, such as 18-19 and 80-84, were underrepresented. This uneven distribution may have introduced a selection bias.

Additionally, household dynamics, where multiple members might not have communicated about the tree, could have affected the accuracy of responses, particularly regarding tree planting.

5.4.3 Time constraints

The short 3-month period between planting and surveying may have led to inaccurate results concerning environmental changes. Longer observation would have provided more confidence in assessing environmental alterations. Furthermore, it's challenging to attribute observed changes solely to the Styx project, as seasonal factors may also play a role. Time constraints also limited the extent of data collection, especially for factors like UTCC.

The various limitations, including potential external influences on community engagement and responses, make it challenging to have complete confidence in the accuracy of all results. Further research may be necessary to obtain a more reliable representation.

6. Recommendations

Based on the research, recommendations have been formulated for future schemes such as the SLLT community tree planting scheme. We advocate that thoughtful, well-planned tree planting, with strong community engagement (Brancalion & Holl, 2020), are important components of ensuring the social and ecological well-being of the planet in the coming decades. Given the success of the tree planting, it is believed there is inevitably great potential for future success in tree planting schemes and increased canopy cover in the Murchison Park area.

It is recommended that the results and feedback from this research should be taken into consideration when planning aspects of any future tree planting schemes. These include choosing areas with and age and gender characteristics associated with high uptake in community projects. These include the three major feedback points collected from the community, these are: more prior notification and communication with the community about the project. Providing plants more variation and choice in plant size. And providing more information about the tree on delivery, such as potential size and appropriate planting locations.

7. Conclusion

In this project's definition, any percentage of trees planted over 60% makes it a success. 60.4% of the trees were planted either on the properties they were delivered to, at the Murchison Park planting day, or at an address in the study area that was not the one it was delivered to. Conclusions are that males and females in the 50-59 age bracket are more likely to plant their trees and in general females are 6% more likely to plant their trees. The community response showed how a large proportion of the community gave a positive response as the success rating and the general feedback was positive.

8. Acknowledgements

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