An evaluation of the factors that influence households' participation and perceptions of the tree and ecological restoration in the eThekwini District, South Africa

by

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ABSTRACT

Ecological restoration, described as the method of assisting the regeneration of an ecosystem that has been degraded, weakened, or lost is an important tool for achieving conservation objectives. Concern for the environment is expanding as a result of increased environmental damage brought on by human activity. Without knowing how people perceive the environment, effective environmental management cannot be achieved. Interactions between people and nature are frequently influenced by their beliefs, perceptions, and environmental concerns. The effectiveness of ecological restoration is seen as being largely dependent on community participation. Understanding factors influencing households' perceptions and participation in restoration assists restoration managers in creating ecological restoration programs that encourage community participation. Hence this study evaluated socioeconomic and demographic factors influencing household perceptions and participation in the tree and ecological restoration in eThekwini Districts, South Africa. Primary data were collected from 160 randomly selected household heads.

Multinomial logistic regression was utilized to evaluate the factors influencing households' decision to participate in the tree and ecological restoration. The results showed that socioeconomic and demographic factors such as age ($p<0.000$), gender ($p<0.030$), years of education ($p<0.000$), and total monthly income ($p<0.077$) statistically significantly influence participation positively, whereas household tenure ($p<0.012$) affects negatively. Ordinal logistic regression was utilized to determine the socioeconomic factors and household demographic characteristics influencing households' perceptions towards trees in their environment. The results showed that socioeconomic factors and household demographic characteristics such as age ($p<0.000$), gender ($p<0.020$), marital status ($p<0.023$) and dwelling type ($p<0.007$) were significant predictors of households' perceptions towards trees in their environment.

Principal component analysis (PCA) was used to generate composite indices representing perceived income from the ecological restoration projects. Ordinary Least Squares was then employed to determine the factors influencing such valuation of the ecological restoration project. The model showed that socioeconomic and demographic factors such as age ($p<0.000$), gender ($p<0.060$), total monthly income ($p<0.039$), years of education ($p<0.001$), household size ($p<0.073$) and access to forest resources ($p<0.032$) influence obtained income from the

restoration project. The study concludes that socioeconomic and demographic elements, which were very important in the research area, should be incorporated into the government policy framework on ecological restoration projects. These factors could encourage local people's involvement in ecological restoration projects if they are thoughtfully incorporated into policy formulation.

Keywords: Ecological restoration, socioeconomic factors, demographic factors, community participation, environmental concerns, household perceptions.

DECLARATION

I, Siphelele Goodenough Soni declare that;

1.The research reported in this thesis, except where otherwise indicated, is my original research.

2. This thesis has not been submitted for any degree or examination at any other university.

3.This thesis does not contain other persons‟ data, pictures, graphs or other information, unless specifically acknowledged as being sourced from other persons.

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List of Acronyms

BLSCRP	Buffelsdraai Landfill Site Community Reforestation Projects
BLR	Binary Logistic Regression
CBC	Community-Based Conservation
CBFM	Community-Based Forest Management
CCB	Climate, Community, and Biodiversity
CDF	Cumulative Distribution Function
CPR	Common Pool Resources
EC	Environmental Concern
EE	Environmental Education
EPRP	Education Promoting Reforestation Project
ER	Ecological Restoration
ERP	Ecological Restoration Projects
ITFL	Indigenous Tree for Life
LPM	Linear Probability Model
MRL	Multinomial Logistic Regression
NTFPs	Non-Timber Forest Products
OLS	Ordinary Least Squares
ORL	Ordinal Logistic Regression
SL	Sustainable Livelihoods
SES	Socioeconomic Status
REDD	Reduce Emission from Deforestation and Degradation

CHAPTER 1: INTRODUCTION

This chapter covers the background of the study, the problem statement, and the justification of the study. It also included the study's research questions as well as objectives. The outline and structure of the study are also presented.

1.1. Background

The growing effects of human activity on local, regional, and global ecosystems have sparked widespread concern and debate, especially since the turn of the century. The destruction of the environment is becoming a big problem in emerging economies. South Africa is a striking example of the major challenges that mankind faces (Brown et al., 2007; Raleigh and Urdal, 2007), where human populations are vulnerable to various social and environmental stresses, with the consequences manifested in increased hunger and water shortages (Rosegrant and Cline, 2003). Due to the growing influence of environmental stresses on human life by increasing desertification, sea level rise, and devastating effects on agriculture, especially in developing countries, this has become a serious concern for the planet (Nathaniel et al., 2019). Environmental preservation, natural resource conservation, and ecological restoration have all been pressing topics of national and international importance. These topics are currently being debated by scientists and policymakers around the world (Nathaniel et al., 2019).

Natural habitats are being transformed and sacrificed at an ever-increasing pace for short-term economic advantage by an increasing human population (Assessment 2005). Tree habitats are deteriorating and disappearing as a result of rapid population growth and economic benefits that make forest conversion look more lucrative than forest protection (Pearce, 2001). Trees and related ecosystems are generally regarded as a nuisance that must be cleared to increase cultivation in most developed countries (Aju, 2014). Most of the confusion about environmental management stems from various groups placing different values on basic amenities (Hummel et al., 2019). However, the world has become more mindful of the importance of sustainability, with trees and associated habitats playing an important part in achieving the Sustainable Development Goals (Swamy et al., 2018). Human populations' health in developing countries,

especially in rural areas, is frequently dependent on locally active environments for basic nutrition (Millennium Ecosystem Assessment, 2005).

Ecological restoration, described as the method of assisting the regeneration of an ecosystem that has been degraded, weakened, or lost (Society for Ecological Restoration International Science and Policy Working Group, 2004), is an important tool for achieving conservation objectives (Hobbs et al., 2011). Ecological regeneration, especially reforestation, afforestation, and the restoration of degraded agricultural land, is frequently regarded as one of the most significant climate change mitigation strategies since such practices have a positive impact on the earth's carbon budget (e.g., Watson et al., 2000; Munasinghe and Swart, 2005). Provided that natural recovery in several environments will take many years, there is also a strong societal incentive to interfere to speed up the process, especially in urban areas where damaged areas are easily visible (Holl and Aide, 2011). For the last few decades, restoration has gained a lot of publicity with policy management traction. Conservation efforts, on the other hand, face several obstacles because the actual economic value of natural forests is widely undefined, and thus unaccounted for in several countries' national economic accounts (Ngoma et al., 2019).

Restoration is now widely recognized as a critical component of meeting environmental and natural-resource sustainability objectives, and small and large-scale restoration projects are becoming more popular around the world (Hobbs et al., 2011). Nevertheless, in developing nations, where most of the biodiversity, as well as poverty, malnutrition, and disease, are concentrated, and where the majority of biodiversity hotspots also exist, both the restoration of deteriorated ecologies and landscapes, and the conservation of nature, will only find support when they are linked to sound socioeconomic research and development, and job creation as well as training (Aronson et al., 2006). However, only a few studies have looked into the impact of socioeconomic factors on household participation in a tree and ecological restoration project. Hence this study aims to evaluate the socioeconomic factors that influence the participation and perception of households towards the tree and ecological restoration in uMgungundlovu and eThekwini district, South Africa. It is necessary to formulate and express holistic explanations and integrated arguments for restoration (Aronson et al., 2006). This is important in trying to encourage rural people's participation in community-based restoration programs. Stakeholder forums are an important component of any active restoration effort and, landscape strategy will help optimize the gains and prevent trade-offs with competing interests of larger-scale initiatives. Obtaining access to good tree planting places and ensuring that such trees may grow

uninterrupted can entail the cooperation and approval of community leaders to farmers and other land users.

1.2. Statement of the Problem

In today's world, environmental degradation is a significant concern, and in South Africa, ecosystem degradation is significant (Sigwela et al., 2017). Due to its negative effects on food production, the climate, and livelihoods, a decline in land quality or impoverishment as a result of human-induced activities remains a serious concern globally (Gupta, 2019). The degradation and conversion of the world's habitats by humans have resulted in widespread biodiversity loss and declines in ecological conditions, resulting in decreased ecosystem service provision (Butchart et al., 2010). The most dangerous threat to humanity in the twenty-first century is the dehumanizing effect of global warming (Charfeddine et al., 2018). Because of population increase and resource use, human activities have had an immense impact on the earth since the turn of the twentieth century, harming natural ecosystems (Sannigrahi et al., 2019). In South Africa, it is estimated that about 5.7 million hectares of undeveloped land have been degraded, and this number might have increased. Rapid and unplanned urbanization, combined with climate change, makes the urban poor more vulnerable to natural disasters.

Globally, population increase and contamination of water, air, and soil add to the increase of human diseases. Environmental pollution is responsible for an estimated 40% of global deaths already (Harris et al., 2012), and this number might have increased now, considering the severity of environmental degradation today due to urbanization and climate change. Economists paid less attention to developing countries environmental problems, especially in terms of their possible contribution to economic development (Masron and Subramaniam, 2019). Environmental scarcities of arable land and water are rapidly affecting hunger, resulting in the loss of livelihoods (Pimentel et al., 2007). Tropical forests are declining globally due to natural and human-caused factors (Ferreira et al., 2018). This decreases biodiversity, changes ecological functionality (Hooper et al., 2012), and jeopardizes the availability of necessary resources for local populations, such as carbon conservation, runoff recycling, and food supply (Duraiappah et al., 2005). Urbanization, deforestation, and cultivation lead to increased flood occurrence and seriousness (Tollan, 2002). Tree development can be affected by urbanization in several ways. Thousands of acres of natural forest have been lost as a result of urbanization. Cities are not the only ones to blame; citizens, in general, are as well (Heusinkvelt, 2016).

Global food security is jeopardized by soil loss and climate change. According to Tully et al., (2015, cited by Gomiero, 2016) soil degradation (nutrient loss is the most common form of soil degradation in Sub-Saharan Africa) is causing a drop in agricultural productivity and has been connected to hunger and poverty in the region. Land destruction makes agroecological processes more vulnerable to climate change and makes response options less successful (Gomiero, 2016). Climate change forecasts show a significant rise in the occurrence and severity of natural disasters, especially storms and flooding, which are the natural hazards that the urban poor are more likely to face (Williams et al., 2019). The effect of floods on the urban poor is compounded by the informal settlements' position on floodplains and their lack of sewage and drainage networks combined with higher runoff from hardened surfaces such as roads and pavements (Sutton et al., 2016). In the South African province of KwaZulu-Natal, the area surrounding the port city of Durban experienced unprecedented rainfall from April 8 to April 12, 2022. The crisis has impacted 19,113, households with 128,743 people in total (Ghosh et al., 2022). In the devastating floods that occurred in 2022, the vulnerable people mostly those who are marginalised and living in informal settlements had limited access to warnings from the eThekwini Municipality and the South African Weather Service. A total of 137 601 ha land area was impacted by floods in the KwaZulu Natal province. (Ghosh et al., 2022). Following floods destroyed livelihoods, homes, land, and infrastructure. Tree restoration is one of the most successful climate change mitigation methods (Bastin et al., 2019). Hence this study seeks to evaluate socioeconomic factors influencing the level of participation and perception of household participants towards the tree and ecological restoration in the uMgungundlovu and eThekwini districts, South Africa.

The state and civil society organizations are under pressure from cities' rapid development to provide sufficient and affordable housing and services for the urban poor, mostly new migrants (Williams et al., 2019). There will be no sustainable growth or effective poverty reduction without environmental conservation (Ohlsson, 2000). Poverty, employment status, cultural values, the status of poorer social classes, and the rights of minorities and ethnic groups all influence a household's decision to participate (Agarwal, 2001). The identification and comprehension of the socioeconomic characteristics of households can be crucial in the development of community-based ecological programs. This is because failing to match community-based tree and ecological programs with the views and values of urban poor and rural households will result in low participation in such programs. Environmental policies are unlikely to work unless they have widespread public support, but the motivations for widespread support

are poorly understood (Bennett et al., 2016). Therefore, there is an urgent need to research socioeconomic factors influencing the level of participation and perception of household participants towards the tree and ecological restoration. This will help formulate relevant policy interventions for the government to mitigate climate change in rural and urban poor household livelihoods. Ecological Conservation is increasingly being viewed as a key strategy for rising environmental service provision and restoring biodiversity losses (Bullock et al., 2011). As a result, tree and ecological restoration could make a significant contribution to solving one of the government's main challenges: poverty alleviation and sustainable growth.

1.3. Research questions

From the statement of the problem above, the following research questions were formulated:

- What is the effect of household characteristics on their participation in ecological restoration programs?
- What are the determinants of households' perceptions of trees in their environment?
- What is the perceived impact of ecological restoration on household livelihoods in peri-urban and rural areas of the eThekwini district?

1.4. Aim and objectives of the study

The study aims to understand and evaluate the socioeconomic factors that influence participation and household participants' perception towards the tree and ecological restoration in the eThekwini district, South Africa. This can be divided into three specific objectives as follows:

1. To determine the effect of household characteristics on their participation in ecological restoration programs.
2. To investigate the determinants of households' perceptions towards trees in their environment.
3. To evaluate the perceived impact of ecological restoration on household livelihoods in peri-urban and rural areas of the eThekwini District.

1.5. Justification of the Study

Environmental perceptions are an important research topic. Concern for the environment is developing as a result of increased environmental deterioration from human-induced activities. There are continual reminders about the repercussions of failing to solve environmental concerns every day (Abdulkarim et al., 2017). Many scientists, as well as local and provincial governments, have established pro-environmental policies and management plans that consider social and ecological factors in conservation (Bennett et al., 2017). However, effective environmental management requires an awareness of people's perceptions and attitudes regarding environmental concerns and conservation (Abdulkarim et al., 2017). Environmental perceptions give insight and are necessary for monitoring, evaluating, and changing conservation and management programs and policies (Bennett, 2016). Understanding how human perceptions interact with the natural environment is critical for creating and implementing successful environmental management strategies (Kangalawe, 2012; Ren and Folta, 2016).

To the best of the researcher's knowledge, this is the first study in a town in KwaZulu Natal, South Africa, evaluating socioeconomic and demographic factors influencing household participation and perception in the tree and ecological restoration. This study aims to contribute to the literature by evaluating households' perception of the environment in the eThekwini district, KwaZulu Natal, South Africa. Environmental concerns have become increasingly worldwide, making research into developing countries' environmental perceptions critical. Environmental perceptions and issues can serve as indications of actual environmental degradation, as well as affect public participation in environmentally friendly initiatives and individual pro-environmental behaviour (Rajapaksa et al., 2018).

1.6. Outline of the study

This thesis is divided into six chapters: an introduction, a literature review, three empirical chapters, and a conclusion. Because the same data was utilized in all three empirical chapters, the study area and data collection procedures are described in the third chapter, which all the following chapters refer to. Chapter 2 covers a review of literature on the definition and discussion of ecological restoration; ecological restoration potential for climate change; evaluation of ecological restoration; tree, forest, and ecological restoration programs; benefits associated with voluntary participation in ecological restoration programs; factors affecting participation in the tree, forest, and ecological restoration; environmental concern and awareness; determinants of environmental perception and attitude; households' values of trees, woods and

forests; ecological restoration contribution to households' livelihoods; benefits of natural capital to peoples' livelihood; the influence of environmental education on attitudes and behaviour; and measurements of perceptions. Chapter 3 focuses on the effect of households' characteristics on their participation in ecological restoration programs followed by chapter 4 which focuses on the determinants of households' perceptions of their environment. Chapter 5 assesses the perceived impact of ecological restoration on household livelihoods in peri-urban and rural areas of the eThekwini district, South Africa followed by the concluding chapter, which represents conclusions and recommendations drawn from the study.

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CHAPTER 2 LITERATURE REVIEW

2.1. Introduction

This chapter presents a review of the evaluation of the socioeconomic factors influencing household participation and perceptions in the tree and ecological restoration. The literature first defines restoration; it provides a brief evaluation of ecological restoration; it highlights factors affecting participation in the tree, forest, and ecological restoration, in terms of perceived economic benefits, utilization and management conflicts, socioeconomic factors as well as institutional factors. Benefits associated with voluntary participation in ecological restoration programs; environmental concerns and awareness are reviewed as well as determinants of environmental perception and attitudes. The literature further highlights household values of trees, woods, and forests; and the tree restoration potential on mitigating the impact of climate change. The literature then went on to discuss ecological restoration's contribution to household livelihood; the benefits of natural capital to people's livelihood; the influence of environmental education on attitudes and behaviour and measurements of perceptions.

2.1.1. Definition and discussion of ecological restoration

Ecological restoration (ER) is the process of supporting the recovery of a degraded, damaged, or destroyed environment (Davis and Slobodkin, 2004). Aronson et al. (2006) added to this bare-bones description, that ecological restoration is a process that restores and improves the functionality of ecosystems in landscapes that include both agriculturally produced lands and set-aside nature reserves. Restoration science arose from the notion that ecosystems may be restored to their pre-disturbance state (Higgs et al., 2018). Ecological restoration is a mainstream idea with dual social and scientific roles that reflects modern scientific and public ideas on how nature is valued and nourishes humans in a variety of ways (Martin, 2017). By incorporating a variety of approaches, restoration is poised to become a go-to solution for tackling future environmental concerns (Higgs et al., 2018). However, there is currently no definition of ecological restoration that emphasizes the dual nature of the process. Ecological restoration differs from other types of ecosystem repair in that it aims to help a natural or semi-natural ecosystem recover rather than imposing a new direction or form (McDonald et al., 2016). Ecological restoration, in other words, puts an ecosystem on a path of recovery so that it can survive, and its species can adapt and evolve. The international standards for the ecological restoration recognize that the phrase

"ecological restoration" is frequently used to refer to both a process (i.e., an activity carried out to achieve a set of objectives) and the desired end for an ecosystem (i.e., its recovery) (McDonald et al., 2016). These Standards describe an ecological restoration activity as any activity whose goal is to accomplish ecosystem recovery, since possible and relative to an acceptable local native model (called a reference ecosystem here), regardless of the time required to reach the recovery outcome (McDonald et al., 2016).

In this study, ER is used as a broad concept to encompass any efforts aimed at improving, and supporting the regeneration of a degraded, destroyed, or damaged environment and re-creating land that has been destroyed and bringing it back into a condition that restores the biological potential through the tree and ecological restoration by active human intervention and action.

2.1.2. Ecological restoration's potential effect on climate change

Ecological restoration is becoming more important in climate change prevention and adaptation policies, such as replanting for carbon sequestration or restoring wetlands for flood prevention (Baker et al., 2014). Ecological restoration can help with climate change mitigation and adaptation in forested ecosystems around the world, while also offering other concrete co-benefits to humans and natural systems (Alexander et al., 2011). In the face of global environmental change, ecological restoration is increasingly motivated by a need to rehabilitate ecological functioning and assure ecosystem service delivery (Baker et al., 2014). Furthermore, it is in increased use as a compensation tool in planning decisions and as a tool for addressing environmental degradation from industrialization, mining, and quarrying as seen, for example, in Germany where an ambitious program of ecological restoration and remediation was undertaken in the new Lander following reunification (Baker et al., 2014).

Ecological restoration, especially (re)afforestation and the restoration of degraded agricultural land, is frequently viewed as one of the most significant solutions to climate change because such activities have a positive impact on the planet's carbon budget (Harris et al., 2006). However, due to the altered biophysical conditions that will be common in the future, climate change has the potential to profoundly influence the practice and consequences of ecological restoration conducted for other goals (Harris et al., 2006). Given the state of many ecosystems, preserving the provision of key ecosystem services necessitates not just the preservation of natural vegetation but also its restoration when appropriate (Bustamante et al., 2019). Carbon intake can be greatly increased as a result of such restoration and regeneration (Bustamante et al., 2019).

Regeneration has ecological and socioeconomic benefits by increasing the flow of ecosystem goods and services (e.g., water, food, timber, and non-timber forest resources, climate control, erosion prevention, and flood control) and creating social and economic development opportunities for rural areas (Suding, 2011).

Ecological restoration has emerged as a critical tool for combating ecosystem degradation, enhancing ecosystem services and biodiversity, and mitigating anthropogenic climate change (Bullock et al., 2011). The most important goal of ecological succession should be to increase ecological resilience to future disturbance (Harris et al., 2006). Reforestation can promote biodiversity, which can contribute to greater primary output, reduced vulnerability to alien species infestation, and improved ecological resilience to stressors like climate change (Van Rooyen et al., 2013). Reforestation can effectively alleviate climate change through sequestrating carbon from the atmosphere, on and around the ground, because trees absorb and retain greater carbon from the atmosphere in their biomass than crops or grasslands (Cunningham et al., 2015). Reduced carbon dioxide emissions from deforestation and degradation, especially in developing nations with significant forests, is an essential strategy for combating climate change (Bustamante et al., 2019).

2.1.3. Evaluation of ecological restoration

Ecological restoration has become an important aspect of conservation efforts around the world since its inception in the 1980s, with projects carried out by the government, community, and corporate stakeholders (Clewell and Aronson, 2012). These pioneering efforts have resulted in ecological restoration being acknowledged as a critical component of long-term global sustainability (Aronson and Alexander, 2013; Higgs et al., 2018), as well as the UN General Assembly declaring the years 2021–2030 to be the "UN Decade on Ecosystem Restoration" (Gallbraith et al., 2021). However, there has been a long-running discussion about what defines "success" in the context of ecological restoration.

Ecological restorationis a rapidly developing topic that is progressing in both theory and practice (Clewell and Aronson, 2013). The goal of ER is to establish an environment that is resilient and self-sustaining in terms of structure, species composition, and function, as well as one that is integrated into the greater landscape and supports long-term livelihoods (Gann and Lamb, 2006). The fast growth of ecological restoration practice necessitates a reconsideration of what constitutes excellent restoration (Monaco et al., 2012). Ecological restoration is becoming a more

popular management strategy around the world. However, for ecological restoration managers, determining how to effectively monitor restoration outcomes and evaluate restoration effectiveness remains a difficulty (Zhang et al., 2020). Effective restoration projects and programs regulate or manipulate biotic and abiotic variables to eliminate risks to an ecosystem, promote or accelerate its recovery, and re-establish connectivity within the greater landscape (Alexander et al., 2011). Successful restoration initiatives must be integrated with social, cultural, and economic frameworks, to account for the needs and wishes of important stakeholders, including local and indigenous groups (Alexander et al., 2011).

Ecological restoration can reverse land degradation, boost biodiversity resilience, and provide essential ecosystem services (Wortley et al., 2013). The method is being widely implemented into natural resource policies at all levels, from local to global; nevertheless, the effectiveness of restoration projects is still unknown (Suding, 2011). This is due in part to the discipline's youngness in comparison to the time it takes for ecological processes to mature; nonetheless, several authors believe that poorly defined aims and a lack of quality (or any) monitoring hinder our understanding of restoration (McDonald and Williams, 2009; Suding, 2011). When it comes to ecological restoration, there are two key obstacles to overcome. One problem is figuring out how to restore huge areas with a range of land uses (Gann and Lamb, 2006). The second question is how to strike a fair balance between promoting biodiversity conservation and improving human well-being (Gann and Lamb, 2006). Setting realistic restoration policy goals for large areas requires not just defining the region's ecological potential, but also linking that potential with social expectations and economic viability (Dodds. et al., 2008).

Empirical restoration success assessments are essential for the practice's development and to support the inclusion of ecological restoration in natural resource management policy. Evaluating restoration is difficult since there are many disagreements on what constitutes effective restoration and how to measure it (Wortley et al., 2013). Hobbs and Norton (1996), offered a framework that helps define the practice of ecological restoration, including the goals and strategies that can be applied, early on in the field's growth. Following that, Higgs (1997), suggested that while setting restoration aims, it is necessary to include historical, social, cultural, political, aesthetic, and moral factors in addition to ecology. Since then, discussions have raged around restoration goals (Thorpe and Stanley, 2011), and socioeconomic factors (Seabrook et al., 2011; Clewell and Aronson, 2012). All of these concerns have an impact on how restoration

success should be defined and quantified and bringing these discussions together could lead to the creation of meaningful indicators.

Judging the success of restoration programs solely based on ecological outcomes is insufficient (Wortley et al., 2013). Identifying and quantifying the socioeconomic benefits given by ecosystems has long been a priority for biodiversity conservation, with extensive research into the economic value of ecosystem services as well as their impact on welfare and community development (Cardinale et al., 2012). Restoration initiatives can be carried out in both urban (Platt, 2006), and rural locations and can target a variety of ecological systems or landscapes (Baker et al., 2014). It is difficult to restore to a specific point of reference in urban settings, however, there are a handful of restoration initiatives that aim to consider both the natural and historical legacies of these locations while incorporating them into ideas for new usage (Westphal et al., 2010). However, adopting an overly broad definition of ecological restoration might lead to the 'value added' of restoration being missed or mixed up with a slew of unrelated social, environmental, or cultural activities (Burger, 2008).

According to an assessment of restoration efforts, ecological restoration programs around the world frequently lack proper evaluation (Suding, 2011; Hagen et al., 2013). However, in recent years, the number of empirical assessments has risen (Wortley et al., 2013). If several years' progress before a restoration is assessed, then if the restoration fails, recovery will be prolonged or unsuccessful (Nilsson et al., 2016). Restoration processes can be enhanced in terms of cost-efficiency and ecological benefits if evaluation steps are correctly stated and justified, and lessons learned can be more easily transferred to future projects (Nilsson et al., 2015).

2.2. Tree, forest, and ecological restoration programs

Over the last few decades, several effective restoration and forestry initiatives have been launched across the globe. Ecological restoration projects (ERP) are becoming more popular around the world, and restoration ecology, the science of carrying out ecological restoration, has acquired widespread acceptance (Aronson, 2010). Attempts at restoration and reforestation have been made in several locations around the world, particularly in developing nations, for instance; the Degraded Area Recovery Program in the Amazon, North Brazil (Bustamante et al., 2019); Restoration of high-diversity tropical forests on a large scale in Southeast Brazil (Rodrigues et al., 2011); Costa Rica is an example of a tropical country that has successfully restored its forests, reforestation of formerly deforested areas to restore the rainforest environment (Janzen and

Hallwachs, 2020); The Education Promoting Reforestation Project (EPRP) in Madagascar, a large-scale community-based reforestation and agroforestry effort that incorporates local species and fast-growing pioneer trees (Manjaribe et al., 2013); and The International Small Group and Tree Planting Program in Kenya, Tanzania, and Uganda (Jindal et al., 2008).

South Africa has several projects as well, for instance, the forest landscape restoration in the Vhembe Biosphere reserve (Constant and Taylor, 2020); the coastal dunes and riparian regions rehabilitation at Port St John (King et al., 2005); the Buffelsdraai Landfill Site Community Reforestation Projects (BLSCRP) in Durban (Douwes et al., 2015); the riparian region's rehabilitation in Letaba river (King et al., 2005); In northern KwaZulu Natal, the coastal dune forest habitat reclamation (Ott and Van Aarde, 2014); the Sandforest Reforestation Initiative in KwaNibela, KwaZulu Natal (Xolo, 2019) as well as the Platbot indigenous forest Restoration program (Jardine, 2019). These efforts help in better understanding how climate change can be regulated while increasing local biodiversity and improving landscape as well as human resilience (Douwes et al., 2015). Reforestation programs must be assessed to verify that they are fulfilling their stated goals, which are largely to recover biodiversity loss (Kanowski et al., 2008). Monitoring regions in the process of forest recovery can be a useful tool for identifying continuing human-induced hazards, thus persistent surveillance of reforested landscapes gauges the effectiveness of restoration after it has been completed (Gerlach et al., 2013).

2.3. Benefits associated with voluntary participation in ecological restoration programs

The rise of ER as a part of environmental preservation has been accompanied by a rise in community-based voluntary restoration participation around the world (Clewell and Aronson, 2013). Ecological restoration is a deliberate human activity that occurs in a variety of complicated and value-laden social environments (Galbraith et al., 2021). Thousands of people devote their free time to participating in a variety of unpaid activities that improve the environment (Guiney and Oberhauser, 2009). Participation, which is often voluntary, is critical in ensuring that projects correspond to the community's needs and capacities as stated by the community people (Markey et al., 2007). Volunteers are essential for most restoration projects; nonetheless, it's important to consider why people devote the time and effort required to complete such monumental tasks. It's not always easy to get enough people to participate, especially in underprivileged communities where there's a lot of impermanence and a lack of community cohesion and commitment (Shragge and Fontan, 2003). Examining the benefits that volunteers receive from participating in restoration operations is one technique to investigate this problem (Heikkila et., 2013).

Examining the benefits could provide important information for finding and encouraging restoration volunteers. The promotion of collective learning or environmental consciousness is one of the key goals of societal participation in restoration initiatives (Heikkila et al., 2013). People learn from one another in collective learning, which allows them to benefit from larger social and ecological systems.

Volunteering can provide several personal and societal benefits. It has been discovered that a person's willingness to participate as well as the anticipated rewards from participation are positively related (Lamb, 2011). The anticipated benefits could include social fairness, municipal service supply, and the development of local institutions to give economic opportunities (Lamb, 2011). Individual benefits can include the opportunity to meet and spend time with new people, as well as the development of skills and leadership (Bang et al., 2013). Volunteers are also motivated by the prospect of gaining tradable benefits such as increased work opportunities as a result of the acquisition of skills, experience, and relationships (Ziemek, 2006). Volunteers who obtain rewards that are related to their major goals are more likely to be satisfied with their work and continue volunteering (Dwyer et al., 2013). Hibbert et al. (2003), discovered a negative association between a person's willingness to participate and related personal expenditures, which include time obligations like paid jobs and childcare, as well as energy levels. Observed barriers to involvement include potential participants' lack of confidence in their ability to contribute to a project, community inhabitants' defeatist attitude based on the perception that nothing will ever be accomplished, and those who wish to leave the community's lack of interest (Hibbert et al., 2003).

A variety of economic theories have been proposed to explain the motive for volunteering as well as the frequency with which it occurs. Rational choice theory, voluntary labour supply theory, human capital theory, and public goods theory are examples of these theories (Lamb, 2011). Some economic models characterize the advantages and costs of participation simply in terms of monetary gain, whereas others use the idea of utility to explain the satisfaction one obtains from one's activities. A benefit could be the sense of personal fulfillment that comes from participating in a communal initiative, regardless of whether it succeeds or fails (Bang et al., 2013). People can be revitalized by spending time in a natural setting, which provides them with a break from their concerns and a restored sense of perspective (Kuo, 2000). Ecological restoration, on the other hand, is more than a natural process. It entails the deliberate act of devoting half of one's time and energy to a subject (Bang et al., 2013). Benefits frequently include both private and

public advantages, whereas costs are typically assessed in terms of time as opportunity costs. Time spent caring for children, indulging in leisure activities, or working for income, for example, are all examples of opportunity costs (Lamb, 2011).

2.4. Factors affecting participation in the tree, forest, and ecological restoration

Project managers can use public participation to discover and answer local people's concerns as well as evaluate their preferences (Phalen, 2009). Participation is defined as "an active process through which beneficiary or client groups influence the direction and execution of the development or management of a natural resource to improve their well-being in terms of income, personal growth, self-reliance, or other values" (Little, 1993). Other socioeconomic (perceived economic benefits, family income levels) as well as demographic (member demographics, institutional history, social networks, and other external factors) aspects influence local people's decisions to join a community-based forest management program (Coulibaly-Lingani et al., 2011), tree and ecological restoration.

2.4.1. Perceived economic cost and benefits

Individuals' decisions to participate in any program depend upon how they perceive the economic benefits of the program (Chhetri et al., 2013). Individuals' participation levels may increase as a result of the benefits they perceive from the tree, forest, and ecological restoration programs. Indeed, Maskey et al. (2006), propose that the benefits obtained from communal forest resources impact the extent to which users participate in management operations. The degree to which the community is reliant on the forest for food or money, their perception of the forest, and the appropriation processes used to extract forest resources are the key elements influencing local forest resource users' participation (Mwangi and Wardell, 2012). As a result, the restoration of degraded ecosystems and landscapes, as well as the conservation of nature, will find support only if they are linked to sound socio-economic research and development, as well as job creation and training, in developing countries, where most biodiversity, as well as most poverty, malnutrition, war, and disease, are concentrated, and where most biodiversity 'hotspots' also occur (Aronson et al., 2006). Households may lack incentives to participate in community forest management activities and engage in sustainable resource management in communities that receive the little benefit (Luswanga and Nuppenau, 2020). This point out the consensus amongst researchers that perceived benefits from ecosystem restoration projects is critical for individual participation in these projects.

Incentives such as financial support, empowerment, livelihood sources, and development programs are needed to encourage active participation from local populations (Paudyal et al., 2018). The incentives and rewards that residents will receive will determine their willingness to participate (Paudyal et al., 2018). The incentives and rewards extend beyond people who participate in ecological restoration projects, and involvement benefits the community as a whole in terms of development (Adams and Hutton, 2007). Receiving no rewards, on the other hand, means that the social goal of the forest and ecological restoration project is overlooked, deterring local people from engaging. According to Cao et al. (2009), abrupt and untimely termination of benefits could induce local people to revert to their previous unsustainable forest resource consumption habits. It is critical to recognize, however, that a never-ending supply of advantages for people is irrational and inefficient (Valenzuela et al., 2020). As a result of participation, people's capacities to develop self-reliance and self-governance should improve, allowing them to attain sustainability (Valenzuela et al., 2020).

The presence of high-revenue-potential resources is likely to pique community members' attention, as well as that of other players such as the government or the business sector (Maskey et al., 2006). Many studies have shown that the economic worth of forests is one of the most important determining factors in people's judgments about whether or not to engage in the management of a common resource. Economic incentives and forest dependence are favorably and strongly correlated with forest residents' participation in forest development, according to Faham et al. (2008), from Iran. In India, Behera and Engel (2006), found that the economic value of forests is critical to the effectiveness of participatory forest management programs. Participatory forest management is more likely for someone who makes a lot of money from forests or whose livelihood is heavily reliant on them. Increased participation in forest governance is encouraged by high degrees of dependency (Lise, 2000). Gebremdhin's study in Ethiopia's south-eastern region also discovered a significant link between forest income and involvement (Gebremdhin, 2008).

2.4.2. Conflicts of utilization and management of restored service

In this study, conflicts are described as incompatibilities between two or more parties' perceived or actual opposing or competing desires, values, and interests relative to the allocation, access, ownership, or exploitation of a resource (Derkyi et al., 2014). Effective conflict resolution necessitates a clear problem description and a thorough understanding of disputes involving common pool resources (Adams et al., 2003). Conflicts over the ownership, management, and

use of recovered resources can make community-based ecological programs difficult to participate in. Within and between communities, conflicts might arise (Mwangi and Wardell, 2012). Conflicts over use and management are the most common problems with restored services and forest resources. Resource conflicts can occasionally become serious and crippling, resulting in violence, resource degradation, livelihood destruction, and community upheaval (Castro and Nielsen, 2001). Governments, their agencies, the private sector, and local communities frequently clash over resource use and control. However, the roots frequently go beyond tangible differences between stakeholders (Adams et al., 2003), and are tied to power dynamics, changing attitudes, and values (Raik et al., 2008), that are founded in social and cultural history.

It's critical to assess the effects of ecological restoration efforts on households' livelihoods for two reasons (Wang et al., 2011). First, these policies may have serious equitable implications, which should be considered and addressed while developing those (Wang et al., 2011). High-biodiversity areas, in particular, are frequently home to poor, rural inhabitants, but the advantages of conservation may benefit affluent citizens of the same or neighbouring countries (Hallet et al., 2013). Mullan et al. (2009), stated that in developing countries, conflicts between conservation and land use occur because households in these countries are likely to have insecure property rights compared to developed countries, hence ecological restoration and conservation efforts may have profound negative effects on their livelihoods. The second reason for considering the effects of conservation projects on local households is that failing to do so may lead to resource conflicts, reducing the program's potential environmental efficacy (Ferraro, 2002).

2.4.3. Socioeconomic and demographic factors

Socioeconomic factors are measurements of a household's production potential, and they are likely to influence the household's decisions and preferences toward the usage of various forest resources (Agrawal and Angelsen, 2009). Therefore, a lack of comprehension of the socioeconomic elements that determine household participation in ecological restoration projects and community-based forest management (CBFM) could hurt the technique used to organize community engagement and its long-term viability. Poverty, livelihood profile, cultural views, status of poorer social groupings, and rights of minorities as well as ethnic groups are among the social elements that influence a household's willingness to participate in CBFM initiatives (Kumar Nath, 2016). The level of participation in management and community-based initiatives can be influenced primarily by social and economic characteristics (Agrawal and Angelsen,

2010). Sex, cultural status, race, class, and income are all important factors in determining how well forests are managed (Sharaunga et al., 2013).

Knowing what motivates individuals to engage in restoration is extremely valuable and will aid managers in developing restoration education, fostering community participation, as well as making investment decisions (Stone et al., 2008). Demographic characteristics such as age, gender, and family size, as well as socioeconomic factors such as educational status, landholding size, level of income, and the number of animals, all influence local people's participation in community-based forest management (Tadesse et al., 2016). Other than socioeconomic and demographic characteristics, there are a variety of other elements that influence local community involvement in community-based forest management and ecological restoration initiatives. These elements may encourage or discourage residents from participating in community-based forest management and ecological restoration initiatives. Institutional, and biophysical factors, incentives as well as the right of ownership are among the factors influencing the involvement of local people (Kura et al., 2021).

Educational status is one of the factors that has received a lot of attention. A study by Kura et al. (2021), has confirmed a positive association between educational level and participation in community-based forest management and participatory forest management as well. Households with higher levels of education are more likely to engage in participatory forest management initiatives (Kura et al., 2021). This is most likely since, in comparison to non-educated households, households with formal education can easily get knowledge regarding forest advantages. The level of income is another factor that has received a lot of attention. Low-income households do not benefit as much from community forestry as wealthier households, according to research by Kumar Nath (2016). They are also less engaged in community participation. This is because low-income households face a significant opportunity cost of participation. After all, the time spent participating may be spent working for cash (Maskey et al., 2003). Sharma (2002), on the other hand, found no class or income bias in the transfer of forest resources, and also that the benefits of community forests were dispersed proportionately among all community groups.

According to a number of empirical investigations, comparable group heterogeneities might have distinct consequences depending on the situation. The consequences of various characteristics of social, political, and economic heterogeneity on resource governance might vary (Maskey et al., 2006). Political and social divisions inside the society might also cause friction among stakeholders, leading to a lack of enthusiasm for CBFM (Agrawal and Angelsen, 2010). Racially

diverse societies have weak social networks and low engagement levels (Sharaunga et al., 2013). As a result, people in racially divided cultures and unequal areas are less likely to form organizations. There is considerable evidence that cultures with higher as well as comparable income categories have higher levels of social participation (Maskey et al., 2006). It indicates that a community's economic uniformity fosters the growth of trust and involvement, as well as makes community activities more manageable (Agarwal, 2001). There is a clear link connecting cultural homogeneity and social capital, particularly in terms of trust and involvement (Sharaunga et al., 2013).

2.4.4. Institutional factors

Institutions are formal or informal protocols, procedures, standards, and conventions ingrained inside organizational structures that can unequally allocate power between interest groups (Sharaunga, 2012). Institutional approaches in political science increasingly include discursive components, with institutions serving as both constraining and enabling conceptions of meaning (Schmidt, 2010). This raises awareness of the need to investigate how restoration policy enters the policy arena, as well as a renewed sense of optimism about restoration's potential in addressing the problem of global environmental change (Baker et al., 2014). Institutions shape the emergence of heterogeneity, which has an impact on levels of trust, the predictability of interactions, and collective action interests (Poteete and Welch, 2004). The impact of institutional factors, and resource features, on the possibility of a group of resource users acting collectively to form institutions for resource management is extensively documented (Markelova and Mwangi, 2010).

The institutional imperative of community management of local natural resources is widely acknowledged (Agarwal, 2001). Local people's participation in forest management is based on the understanding that long-term development requires strengthening rural people's ability to influence and control the methods by which they make a living (Markelova and Mwangi, 2010). As the cornerstone of the participatory approach, local communities play a critical role in the success of this management plan, therefore increasing their engagement is critical (Valenzuela et al., 2020). Many countries have implemented participatory management as a significant technique for natural resource protection and management (Valenzuela et al., 2020). It understands the importance of addressing social and environmental issues as a whole, because they are intertwined (Adams et al., 2013). Monitoring and penalizing have been demonstrated to be important factors in successful common pool resource (CPR) management (Coleman, 2009).

Institutions help to mitigate the consequences of population pressure and varying distances from forest resources (Sharaunga et al., 2013).

Many developing countries have used the devolution of forest resource management and access rights to local populations as a policy instrument in recent years (Behera, 2006). One of the most frequently stated goals of devolution and community-based natural resource management is to provide a place for local communities to participate in and benefit from policy changes by asserting their interests and needs (Behera, 2003). Whether community members would engage time and effort in the sustainable management of forests is influenced by property rights and their security (the belief that rights and benefits to forests will not be rejected) (Mwangi et al., 2011). As a result, in the last few decades, there has been a significant shift in forest resource management, with countries devolving at least some rights and duties over their forests to users (Behera, 2006). Discoveries on institutional arrangements for community forestry show that rules that are straightforward to comprehend and impose, domestically designed and largely acknowledged, take into consideration multiple kinds of violations, assist in conflict resolution, and keep users and authorities responsible are the most probable to lead to important dependent participation in community forest management (Castro-Nunez et al., 2017).

Many governments have initiated policy attempts to acknowledge customary management systems, encourage local engagement in forest activities, raise community benefits from forests, and address enforcement, equality, and livelihood issues that plague poorly administered forests (Agrawal and Angelsen, 2009).

2.5. Environmental concern and awareness

Environmental concern (EC) is defined as a measure of a person's understanding of environmental concerns and ability to directly contribute to their resolution (Kim and Choi, 2005). Social scientists have been studying the influence of socioeconomic status and individual traits in the development of environmental perceptions and efforts to combat degradation for numerous years (Jacobs, 2002: White and Hunter, 2009) and yet the direction and significance of some of these correlations may differ across studies. One body of research led to the conclusion that EC and protection were more likely to be found in industrialized societies with higher socioeconomic class populations (Bronfman et al., 2015). Other research disagreed, claiming that developing civilizations know about environmental contamination as well as a readiness to act to reduce it (Jacobs, 2002; White and Hunter, 2009). The conclusions from these

researches all agree that socioeconomic issues have varying degrees of influence based on both individual circumstances and the specific environmental concerns being investigated.

Many sociodemographic characteristics have been linked to pro-environmental behaviour. Gender and environmental concerns appear to have a tumultuous relationship. Due to cultural and social-structural variables that make them more aware of the links between causes and repercussions of environmental harm, females are more likely to engage in pro-environmental behaviour (Wan and Du, 2022). Women, according to research, are more worried about the environment than men (Chileshe, 2020). Women are the primary fuel-wood collectors; hence they are the ones who are most likely to experience the impacts of deforestation (Barber et al., 2003). Others, on the other hand, have discovered that men are more environmentally conscious than women (Huddart et al., 2009). For the link between education and environmental concerns, most empirical studies have found a positive relationship. Educated people are exposed to more information concerning environmental harm as a result of their education and are more inclined to engage in pro-environmental actions (Chen et al., 2011). For the link between age and environmental concerns, studies conducted in western countries show that younger people are more concerned about environmental issues than old people (Gifford and Nilsson, 2014). This age impact, according to some researchers, is due to generational value shifts (Dlamini et al., 2020). Others suggest that the age effect is caused by greater education and knowledge about environmental issues among the young (Chen et al., 2011)

Place of residence is another aspect that has attracted a lot of attention. Empirical findings about the place of residence and environmental concerns are mixed. Initial research on environmental concerns between rural and urban inhabitants revealed that urban dwellers were more concerned about the environment (Gifford and Nilsson, 2014; Liu and Mu, 2016). Rural residents are thought to have a lower level of education, lesser wealth, and utilitarian value orientation, which explains these inequalities (Huddart et al., 2009). Educational attainment and income, and exposure to higher degrees of environmental damage, like contamination, are often more common among city dwellers, leading to beliefs, values, and attitudes more favorable to environmental protection (Saphores et al., 2006). However, recent research suggests that the divide between rural and urban citizens is narrowing. For instance, when the impacts of demographic variables were controlled, Liu and Mu (2016), showed no differences in environmental concern between urban and rural inhabitants in the southern United States on cognitive, affective, and behavioural markers.

The behavioural and cognitive components of environmental concern have been identified (Huddart et al., 2009). Individuals' direct involvement in actions that help the environment is included in the behavioural component (Huddart et al., 2009). Basic values, environmental worldviews, and attitudes are all part of the cognitive aspect of environmental care (Stern, 2000). As a result, the cognitive factors indicate a proclivity to act in favour of the environment or to support legislation and efforts aimed at environmental conservation (Stern, 2000). As people become increasingly concerned about various components of the environment, more precise attitudes about specific behaviours will emerge, influencing feelings of personal accountability for an act and verbal commitment to a problem or issue resolution (Cottrell, 2003). The greater one's sense of responsibility, the greater one's commitment to carrying out a specific act. Personal commitment to a certain action is influenced by awareness of the repercussions of one's actions (Cottrell, 2003).

2.6. Determinants of environmental perception and attitudes

Environmental perceptions pertain to how an individual observes or evaluates environmental concerns (Hunter et al., 2010), whereas environmental concern refers to the effect or feeling connected with environmental issues such as resource availability, accessibility, and environmental quality (Bennett, 2016). As a result, environmental concern is a distinct aspect of broader environmental perceptions. Environmental concern, according to Carmi et al. (2015), refers to the effect linked with environmental concerns, whereas environmental attitude refers to a person's collection of beliefs, affect, and behavioural intentions toward ecologically connected activities or situations. EC is one facet of an environmental attitude, according to this viewpoint. EC, therefore, represents a distinct facet of broader environmental perceptions and attitudes.

Understanding the drivers of environmental perceptions and attitudes, which have ramifications for human–nature relationships, is one method academics can encourage sustainable and pro-environmental behaviour (Choudri et al., 2016). Increased environmental concerns are often used alternately with human attitudes toward the environment, which reflect human tendencies and impact their behaviour in a specific way (Milfont and Duckitt, 2004). Several studies have shown that a person's environmental perceptions and attitudes, as well as their subsequent environmental behaviour, can be influenced by a variety of personal and objectively driven factors (Glifford and Nilsson, 2014). Individuals who are concerned about environmental issues and are well-informed about them are more likely to support environmental causes regularly by signing petitions, voting for pro-environmental problems, and possibly able to contribute time and money to particular

environmental campaigns (Choudri et al., 2016). Organizations must comprehend how different groups vary in their attitudes toward their environment, their awareness of environmental problems, and the motivations that fuel their environmental practices, as well as the practical pro-environmental behaviours in which individuals engage (Wiernik et al., 2013).

Studies have pointed out that environmental perceptions and attitudes are affected by sociodemographic and socioeconomic factors. Sociodemographic and socioeconomic factors like age, gender, education level, employment status, place of residence, and income are elements that have been found to influence environmental perceptions and attitudes (Barber et al., 2003; Dlamini et al., 2020). The most consistent results show that environment supporters are young and educated individuals (Xiao and McCright, 2012). Age is one of the factors that has been associated with both environmental perceptions and attitudes. The findings of the link between environmental age and environmental perceptions and attitudes are inconsistent. Younger individuals are thought to have less strict environmental perceptions and to be less concerned about the environment (Wong and Wan, 2011). Nevertheless, Ramkissoon et al. (2013) observed declining levels of environmental perceptions in practically all age categories in research on cohort group variations in concern for the environment. Pampel and Hunter (2012), examined a wide variety of American studies on environmental concerns and found a negative relationship between environmental perceptions and attitudes as people get older. Even though these studies have found a negative link between age and environmental sentiments, it is more typical to establish a link between age and pro-environmental behaviour (Ramkissoon et al., 2013). However, a study by Dlamini et al. (2020), discovered that age had no bearing on environmental perceptions and attitudes.

Socioeconomic status, as measured by levels of income and employment position, seems to be another socio-demographic factor of environmental perceptions and attitudes which has garnered attention in the literature. High-income earners are much more likely to reside in environmentally pleasant locations and are thus more environmentally conscious (Rajapaksa et al., 2018). As a result, higher-earning people are more worried about the environment than lower-earning people (Rajapaksa et al., 2018). Employment status is a strong predictor of environmental perceptions (Dlamini et al., 2020). The state of one's employment is a factor in the economy. Economic conditions and environment studies have looked at how economic conditions may influence environmental attitudes rather than employment status per se (Diamantopoulos et al., 2003). Hunter et al. (2010) discovered that perceptions and attitudes change as a result of one's

livelihood, socioeconomic status, and personal experience, implying that one's employment or socioeconomic background alone combines with other influences in a sophisticated way to determine one's attitude toward the environment.

Education level is another factor that has received a lot of attention. The link between education and environmental perception and attitude is a positive one. Higher levels of education are one of the strongest influences on environmental attitudes and perceptions (Dlamini et al., 2020). Formal environmental education has a favourable impact on attitudes toward nature and the environment (Damerell et al., 2013). Gender is another factor that received attention. The empirical findings regarding the predictive power of gender are mixed. Gender has been proven to influence environmental perceptions in households, with females being much more anxious to conserve the environment than males (Xiao and McCright, 2012). This is in line with the socialization idea, which claims that there is considerable empirical evidence that women are more environmentally conscious than men (Dietz et al., 2002). Dlamini et al. (2020) discovered that gender is not a powerful determinant of perceptions and attitudes by itself, but rather interacts with other variables such as language as well as ethnicity to influence environmental concern.

In the debate over socioeconomic as well as demographic factors influencing environmental perceptions and attitudes, the availability and non-availability of electricity in houses have received little attention. Electricity availability has been an issue in studies that have focused on environmental concerns in general (Willers, 1996). However, electricity availability was identified as one of the important determinants of environmental perceptions in a study conducted by Dlamini and others (2020). This is unsurprising in the context of South Africa, where household power availability is mostly determined by socioeconomic status (SES) as well as the type of dwelling.

Knowledge about the environment, duration of stay in a place, immigrant status, access to facilities, place of living (rural/urban), and religion have all been identified as major drivers of environmental perceptions and attitudes. Environmental perceptions, as well as attitudes, may be influenced by environmental knowledge, as knowledge of environmental themes contributes to pro-environmental behaviour (Liu et al., 2020). According to studies, living in a city for a longer period is related to a higher level of environmentalism, and rural residents who rely more on the land are more environmentally conscious (Gifford and Nilsson, 2014). Place bonding results in particular environmental behaviours that are influenced by environmental perceptions and attitudes hence length of stay and immigration status have been connected to environmental

perceptions and attitudes (Dlamini et al., 2020). Access to facilities such as water and waste disposal facilities in urban areas could result in people evolving specific environmental perceptions and attitudes, as behaviours and awareness of water pollution and waste disposal result in some levels of environmental awareness, particularly in developing countries (Dlamini et al., 2020). All of these characteristics have an impact on how people see their role in the environment and, as a result, their perceptions and attitudes toward it (Lazri and Konisky, 2019).

2.7. Households' values of trees, woods, and forests

The term value is defined differently in different disciplines. Held values are styles of behaviour, ethical standards, or end states, while assigned values are the comparative value of a product or economic value (Owen et al., 2009). According to the research, knowing people's environmental value orientations might assist authorities predict how they will interact with natural resources and develop suitable environmental regulations. As people's values evolve, their perceptions of forests shift (Li et al., 2010). As a result, when it comes to forests, the term value can be applied in a variety of ways. Forests provide value in one sense because of the activities or purposes they serve in human use, such as timber, clean water, and recreation (Sharaunga et al., 2013). In other meaning, forest values refer to the scales or standards that are used to make specific decisions and serve as the foundation for evaluating management approaches (Ives and Kendal, 2014). In addition, the term value is used differently across fields. The phrase is usually used by ecologists to refer to "something desirable or worthy of admiration for its own sake" (Freeman et al., 2014). The economic value of a resource or environmental system, according to economists, is determined by the benefits that ecosystem functions and services provided to human well-being (Freeman et al., 2014).

Forest values are beliefs about forests that reflect a person's attitude toward them (Clark, 2011). Forest values and value categories or orientations have been established in numerous types of research. People's attitudes toward forest resources are predicted by four types of environmental value orientations: utilitarian, ecology, sentiment, and negativity (Li et al., 2010). The major role of forests, according to a utilitarian value orientation, is to provide commodity advantages (Sharaunga et al., 2013). A nature-centred approach stressing environmental protection and ecosystem management is referred to as an ecological value orientation (Ives and Kendal, 2014). People's views toward environmental management can be studied using a continuum of utilitarian and ecological value orientations (Li et al., 2010). A sentiment value orientation is a philosophical foundation for enjoying the roles of forest resources in environmental education, promoting

mental and physical health, adoring environmental aesthetics, recognizing historical significance, and embracing virtue ethics (Bengston et al., 2004). Negativity is the fourth environmental value orientation. Negative value orientation is described as a concern about the forest due to a sense of safety in it (Li et al., 2010).

Native forests are linked to many socioeconomic benefits around the world. One method of articulating these values from a strictly anthropocentric perspective is the diversity of uses and advantages forests bring to nearby communities and those further away (Raymond et al., 2013) Instrumental and non-instrumental, material and non-material, anthropocentric and bio-centric are some of the most main forms of held values (Owen et al., 2009). Aesthetic, cultural, spiritual, educational, and ethical values are frequently related to non-use categories such as non-instrumental, non-material, and bio-centric (Sharaunga et al., 2015). Increased acknowledgment of the socioeconomic value of intact forest ecosystems could help provide major incentives for reforestation. Forest values or forest value orientations are patterns of underlying beliefs that consolidate and provide significance to essential values held by households (Berninger and Kneeshaw, 2009). Fundamental values are bolstered and given greater meaning by basic beliefs. Value orientations are formed through patterns of underlying ideas (Sharaunga et al., 2015).

Some scholars have identified the direct and indirect values of South African forests (Dovie et al., 2002; Shackleton and Shackleton, 2006). The cultural importance of forest ecosystems, environmental awareness, and direct or indirect advantages individuals obtain from natural ecosystems may all have an impact on the values societies place on them (Chan et al., 2011). Forests are important assets to communities in South Africa because they supply essential goods and services supporting rural livelihoods. For a huge number of rural poor people, forests as well as forest resources are typically a crucial socio-economic support system (Makhado et al., 2009). Forest goods and services make a substantial contribution to food security and fundamental well-being in rural communities, especially among impoverished people in local communities (Chan et al., 2011). The majority of forests and woodlands generate timber for sale or personal use (Agustino et al., 2011). Despite great increases in power availability, the majority of rural and a substantial percentage of urban South Africans remain dependent on wood fuel as a main source of power for cooking (Shackleton, 2009). People in rural areas of South Africa benefit from edible fruits, mushrooms, and natural spinaches as nutritional supplements (Sharaunga et al., 2012). Forests and trees on fields, on the other hand, provide a wide range of products and services, from animal fodder to recreational, aesthetic, and environmental values (Agustino et

al., 2011). Many rural South Africans understand that plants may minimize soil erosion as well as landslides in coastal and inland regions (Sharaunga et al., 2015).

2.8. Ecological restoration contribution to households' livelihood

People's livelihoods are impacted by the social impact of ecological restoration. Livelihoods and environmental rehabilitation are inextricably intertwined, particularly in rural areas. To create sustainable livelihoods, it is necessary to first comprehend what a livelihood is and how it relates to ecological restoration. The capabilities and assets that people require to make a living and sustain their well-being are referred to as livelihoods (UNDP, 2010). The Brundtland Commission first introduced the term "livelihood" as a method for analysing human activities in terms of environmental sustainability (UNDP, 2010). When it comes to the word "livelihood", many people have various interpretations. People frequently link the term "livelihood" with the ability to make money; nevertheless, livelihood encompasses more than just revenue (Kheswa, 2019). According to Wang et al. (2011), a livelihood includes an income, both cash and in kind, as well as the social structures (kin, family, compound, village, and so on), gender relations, and property rights required to maintain and preserve a certain quality of life. According to Pasanchay and Schott (2021), a livelihood consists of the capabilities, assets (both material and social resources), and activities essential for survival. There is a consensus that a livelihood is more than just the ability to make money, therefore for ecological restoration projects to be considered impactful to rural livelihoods they should contribute to all the livelihood assets. A livelihood is sustainable when it can withstand and recover from stress and shocks, as well as preserve or improve its capabilities and assets in the present and future, without jeopardizing the natural resource base (Kheswa, 2019).

Reforestation programs seek to improve community-based empowerment, environmental knowledge, and awareness, and enhance community incomes as well as livelihood diversity in terms of their influence on livelihoods (Le et al., 2012). The confirmation benchmarks of institutions like the Climate, Community, and Biodiversity (CCB) certification scheme, as well as interventions to reduce emissions from deforestation and degradation (REDD+) that also strive to integrate social and economic benefits, reflect one such concept of boosting community level development (Lawlor et al., 2013). The restoration of tropical forest resources, which are vital to the livelihoods of millions of rural people, can have a favourable impact on local livelihoods. Water filtration and crop pollination (by providing a home for insect pollinators, birds, and mammals) are also important for rural livelihoods (Adams et al., 2013). Ecological restoration is

particularly essential because of its inherent ability to allow people to not only repair ecological damage but also to better their own lives (Gann et al., 2019). Ecological restoration has helped local populations renew economic prospects, revitalize traditional cultural traditions, and refocus their goals in many cases (Gann et al., 2019).

The most obvious method in which ecological restoration helps livelihoods is through the repair of natural capital and improved flow of ecosystem services; nevertheless, restoration initiatives can have a variety of effects on local livelihoods (Herrera, 2017). They frequently assist direct asset accumulation or access, in addition to natural capital, on which livelihoods are based (Herrera, 2017). They may, for example, contribute to the development of institutions, connections, social networks, and trust among individuals, all of which contribute to social capital. Individuals and groups can also benefit from projects that help them develop organizational capacity so that they can participate in natural resource management (Nielsen-Pincus and Moseley, 2013). These projects frequently incorporate training in restoration activities, including the pragmatic utilization of organic fertilizers or soil depletion protection, as well as a variety of other subjects, including first aid or conflict management (Blignaut et al., 2011), all of which contribute to the development of human capital (Nielsen-Pincus and Moseley, 2013). Furthermore, these projects may attract finance and new business prospects, increasing the financial capital of those involved (Nielsen-Pincus and Moseley, 2013; Baker et al., 2014).

The study of rural environmental sustainability has focused on integrating poverty reduction with ecological restoration (Wang et al., 2011). Within the scope of restoration initiatives, the goals of socioeconomic benefits, ecosystem goods, and services have been added in an attempt to contribute to the livelihoods of local people. For instance, poverty reduction is one of the goals of the Buffelsdraai Landfill Site Community Reforestation Projects (BLSCRP), through the Indigenous Trees for Life program. The Indigenous Trees for Life (ITFL) program involves local community members, referred to as tree-preneurs, in the collecting and growth of tree seedlings, which are then preserved in nurseries and then planted in the buffer zone, to alleviate poverty (Douwes et al., 2015). The tree-preneurs exchange their trees for credit notes, which they can use to enhance their income streams (Douwes et al., 2015). Restoring ecological functions brings plenty of benefits to rural livelihoods, including improved food and water security, wood resources, and flood and other natural catastrophe protection (Hartman et al., 2016).

2.9. Benefits of natural capital to people's livelihood.

Natural resources, or natural capital, are resource pools through which resource flows as well as services relevant to lives are generated, (Barbier, 2012). Natural resources are commonly regarded to be the foundation of many livelihoods, particularly in rural areas (Alemu, 2012; Barbier, 2012). Natural resources are becoming more important and valuable in the lives of rural communities all over the world, and there is a growing international awareness of this (Zheng et al., 2019). These resources are used by households daily to ensure their survival. People can use natural resources for farming, fishing, hunting, and mining (Furusa, 2013). Household fundamental requirements such as food, housing, clothes, and warmth are met through these extractive activities (Furusa, 2013). According to research, low-income households in developing nations such as South Africa used more non-timber forest products (NFTPs) per capita than wealthy households, including firewood, wild foods, wild edibles, and grass hand brushes (Herd-Hoare and Shackleton, 2022). Vedeld et al. (2007), perform a meta-analysis of 54 case studies of rural populations living in the surrounding tropical forests around the world, finding that natural resources specifically forest resources account for 22 percent of household income in these areas on average.

Natural capital's benefits to people's livelihoods and well-being have been extensively researched (Zorondo-Rodriguez et al., 2016). Ecosystem services like NFTPs (e.g., food, fuelwood) gathered by rural households with Direct Use Value have a significant impact on rural households' livelihoods (Kalaba et al., 2013). South African households typically use a variety of NFTPs to suit their daily requirements. Wild spinaches, fuelwood, wooden utensils, grass hand-brushes, edible fruits, and twig hand-brushes are the most regularly utilized products, with 85 percent or more of households using them (Shackleton and Shackleton, 2006). They help people secure their livelihoods, particularly in rural areas. Natural capital appears to serve three primary functions in rural communities: it actively supports consumption demands, offers safety nets, and serves as a road out of poverty, according to evidence (Fisher, 2004). This contribution is especially important in times of crisis for people's livelihoods. In severe economic circumstances, rural households adopt central coping techniques such as substituting purchased commodities with products harvested from natural surroundings or temporarily selling natural products to supplement household income (Shackleton and Shackleton, 2006).

The necessity and value of natural resource utilization in rural communities are becoming more widely recognized (Luckert and Campbell, 2012). Forest revenue accounts for 30 percent of household income in rural Malawi, according to Fisher (2004). Rural households' livelihoods are

directly or indirectly related to the natural resource base in most developing countries (Shackleton and Shackleton, 2006). This is mostly because a large percentage of the population relies on agriculture as well as other primary industry activities to survive (Babulo et al., 2009). Natural resources directly provide a wide array of goods and services to rural families, in addition to being factors in agricultural production: consumption goods, consumer durables, production inputs, components to productive capital, assets, as well as many indirect benefits (Babulo et al., 2009). Non-cultivated forest-related resources provide subsistence and monetary incomes to a range of households, from those who rely on them almost totally to others who don't (Vedeld et al., 2007).

Natural resources have historically been the basis of rural livelihoods throughout Africa (Slater and Twyman, 2003). Rural populations have primarily used and consumed natural resources for survival (Sunderlin et., al 2005). Rural households and communities benefited greatly from natural resources in terms of food security, fuel, and medicine (Mofokeng, 2008). The contributions of natural resources to rural people make them important components of sophisticated and varied rural livelihoods. Ecological degradation and deforestation, on the other hand, pose a serious threat to the richness of available resources. Deforestation is linked to rural livelihood practices such as firewood gathering, timber harvesting (for domestic consumption or for selling to metropolitan areas), agricultural expansion, and pasture field extension (Casse et al., 2004). The extraction of natural resources also serves as a safety net (Nawrotzki et al., 2012). Such a safety net is especially vital for low-income and vulnerable families (Hunter et al., 2011; Shackleton and Shackleton, 2006). The case of harvest failures, natural calamities, and the death of a breadwinner have all been proven to lead to households turning to forest product extraction in various African settings (Hunter et al., 2007; Hunter et al., 2011) In moments of crisis, coping mechanisms could include replacing previously acquired products with natural equivalents or temporarily selling natural products and handcrafts to boost family income (Shackleton and Shackleton 2006).

The recovery of natural capital and the essential economic benefits that come with it are the practical promise of ecological restoration (Clewell and Aronson, 2013). Natural asset development strategies that put natural assets in the hands of the rural populations that rely on them could help mitigate poverty and reduce deforestation (Nkoana, 2014). Agriculture and natural resource utilization are inextricably linked to rural livelihoods in the least developed nations (Shaanker et al., 2004). Rural households collect raw products like fuelwood, medical

herbs, and lumber, as well as benefit from public goods like erosion management, climate stability, and safe drinking water (Nkoana, 2014).

2.10. Influence of environmental education on attitudes and behaviour

There have been and continue to be many distinct definitions of environmental education. Environmental Education (EE) is a learning process that improves people's understanding and awareness of the environment and its challenges, develops the skills and knowledge needed to tackle the problem, and fosters perceptions, intentions, and responsibilities to make decisions and to take appropriate action (Sola, 2014). This is how the current study interprets environmental education as well. The purpose of EE is to create individuals who are responsible for the entire environment, concerned about it and its associated challenges, and who work together to solve present issues and reduce new ones (Sola, 2014). EE is an important tool in the conservationist's toolkit since it may expand knowledge, improve attitudes, and possibly change behaviour (Vaughan et al., 2003). Environmental awareness and good comprehension should be strongly ingrained in the educational process at all stages of school education, according to global academics and environmental experts (Shukla, 2009).

EE aims to raise environmental awareness and concern among the global population while also promoting the development of information, skills, attitudes, motivations, and commitment to finding solutions to environmental challenges through individual and community action (Karatas and Karatas, 2016). Concerns over the environment's rapidly deteriorating state have stressed the importance of environmental education around the world (Sola, 2014). Environmental education initiatives should enhance public awareness and encourage natural resource management activities. Children are a common intended audience since attitudes toward the environment develop at a young age and are difficult to change once formed (Asunta, 2003). Children are far less prone to have well-established environmentally detrimental behaviours to unlearn, have a longer time of influence over environmental quality, and may be effective agents in encouraging others to behave responsibly (Williams, 2011). According to Sola (2014), kids in junior high and high school who took particular environmental classes exhibited better behaviour and concern for the environment. Whilst these are robust reasons for targeting children with environmental education, many serious environmental issues require swift, decisive action. As a result, environmental education may want to focus on those who can implement rapid change by changing their behaviours and advocating for legislative change (Damerell et al., 2013).

The fundamental goal of environmental education initiatives has been to improve people's attitudes toward the environment by enhancing their environmental knowledge (Sola, 2014). Given that knowledge is one of the most important predictors of behaviour, all persons should be provided with more environmental knowledge and information to modify their environmental attitudes and actions (Paco et al., 2017). Because one of the stated goals of environmental education is to modify behaviour, it is critical to comprehend the foundations of environmental attitudes to support environmental behaviour change (Asunta, 2003). It is also well-recognized that imparting environmental knowledge does not always lead to positive environmental attitudes. Halpenny (2010), identified three categories in which an individual's response to the environment is based: emotive, cognitive, and behavioural.

2.11. Measurements of determinates of participation and perceptions

The empirical methodologies that have been used to analyse perceptions are outlined in this section. There is no scientific agreement on which measurement technique should be used to measure perceptions. The measurements of perceptions vary across disciplines but for this study, our focus will be on econometric methods of assessing perceptions. The logistic regression model (e.g., specifically binary and multinomial) has long been a popular tool for analysing people's perceptions. The binary logistic regression model is employed when the outcome variables have two levels, and the multinomial logistic regression is used in the case where the outcome variable has more than two levels. Logistic regression is favoured due to its appropriateness in modelling categorical outcome variables.

Uddin et al. (2017), in the coastal region of Bangladesh, identified determinants of farmers' perception of climate change. The binary logistic regression was employed to identify determinants of farmers' perception of climate change. Education, family size, farm size, family income, agricultural experiences, and training obtained were found to be significant and influential elements in climate change perception. Different probability models with a dummy outcome variable could have been used to examine the data (Uddin et al., 2017). The Linear Probability Model (LPM), logit model, and probit model were all taken into consideration. The logit model was justified based on the following shortcomings of the LPM and probit models. The LPM demonstrated the homogeneity of error terms as well as the capability of obtaining a probability function result from a range of 0 to 1 (Uddin et al., 2017). LPM is not a logically appealing model for dummy responsive variables because of this issue. When evaluating this type of questionnaire, it is preferable to utilize Cumulative Distribution Function (CDF) models,

such as logit or probit models (Gujarati, 2021). The probit model is more suited to experimental data, whereas the logit model is better suited to observational data The information gathered was classified as observational. As a result, a logit model was employed to determine the factors influencing farmers' views on climate change. Furthermore, a logit model ensures that the predicted probability rises and never falls outside the range of 0 to 1 (Uddin et al., 2014).

Abid et al. (2015), in Punjab province, Pakistan identified farmers' perceptions of and adaptation to climate change and their determinants. The binary logistic regression model was employed to identify farmers' perceptions of and adaptation to climate change and their determinants. Education, farm experience, household size, land area, tenancy status, ownership of a tube well, access to market information, weather forecasting information, and agricultural extension services all influence farmers' adaptation measures choices, according to the binary logistic model's findings. The findings also show that adaptation to climate change is hampered by many variables in the research area, including a lack of information, a lack of funds, resource limits, and a lack of irrigation water.

Dlamini et al. (2020), in Gauteng province, South Africa identified determinants of environmental perceptions and attitudes in a socio-demographically diverse urban setup. A generalized ordered logit model (gologit) approach was used. Gender, education level, employment status, age, population group, and migration status were investigated as predictors of environmental perceptions and attitudes using a questionnaire. External variables such as dwelling type and electricity availability were also assessed. Environmental attitudes were strongly influenced by dwelling type, gender, education level, birthplace, and employment status, according to statistical findings. Environmental perceptions were found to be significantly influenced by population group (coloured and white), house type, power availability, employment situation, and education level (from primary to matric). As a result, the study's common explanatory factors were education level, housing type, and employment status, emphasizing the material values that people attach to environmental attitudes and perceptions. Both environmental perceptions and attitudes were unaffected by age.

Opiyo et al. (2015), in Turkana, north-western Kenya identified determinants of perceptions of climate change and adaptation among Turkana pastoralists. Descriptive statistics and the Heckman Probit model were used to identify determinants of perception of climate change and adaptation among pastoralists. The findings demonstrate that the majority of households perceived those temperatures have risen and rainfall variability has increased during the last three

decades. Gender and education level of the household head, household size, wealth in terms of livestock ownership, distance to markets, access to credit, and extension services are all factors influencing pastoralists' choices of climate change adaptation, according to Heckman's sample selectivity probit model.

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CHAPTER 3: FACTORS AFFECTING HOUSEHOLDS PARTICIPATION IN ECOLOGICAL RESTORATION PROGRAMMES IN ETHEKWINI DISTRICT SOUTH AFRICA

Abstract

The effectiveness of ecological restoration is seen as being largely dependent on community participation. Understanding factors influencing household participation in restoration assists restoration managers in creating ecological restoration programs that encourage community participation. Hence this study examined the socioeconomic and demographic factors influencing household participation in tree and ecological restoration projects. Primary data were collected from 160 randomly selected household heads. Descriptive statistics such as cross tabulation, percentages, frequencies, and chi-square were utilized to describe household characteristics. The Chi-Square test for independence was utilized to test for association between categorical variables. Multinomial logistic regression was utilized to evaluate the factors influencing household participation in ecological restoration programs. The results showed that socioeconomic and demographic factors such as age ($p<0.000$), gender ($p<0.030$), years of education ($p<0.000$), total monthly income ($p<0.077$) statistically significantly influence positively, whereas household tenure ($p<0.012$) affects negatively. The study concludes that socioeconomic and demographic elements, which were very important in the research area, should be incorporated into the Provincial and local municipality policy framework on ecological restoration projects. These factors could encourage local people's involvement in ecological restoration projects if they are thoughtfully incorporated into policy formation.

Keywords: Socioeconomic factors, demographic factors, household participation, ecological restoration, tree restoration

3.1. Introduction

Local participation is a critical aspect in influencing the success and results of environmental and natural resource management projects and thereby increasing land quality (Apipoonyanon et al., 2020). According to Sahai (2015), community participation acknowledges that all actors are equal, and communicate information, resources, and skills to manage their natural environment. Local people benefit from participation in community development and natural resource management initiatives by fixing environmental concerns and enhancing livelihoods (Ting et al., 2011). Individual household characteristics determine behaviour including whether or not to

participate in ecosystem restoration programs. Community participation is seen as critical for success in ecosystem restoration. Therefore, understanding the social dynamics of society is essential for successful community involvement. For effective ecosystem restoration projects, it is critical to know the socioeconomic and restorative elements that stimulate and hinder restoration efforts. This aids in determining the individual needs and options in light of its surroundings. It also helps in understanding people's and individuals' distinctive lifestyles at a community scale, based on socioeconomic and environmental challenges (Gumede, 2019).

In this chapter the conceptual approach of the study is discussed, a description of the study area is given, and sampling procedures are discussed. The empirical findings regarding the effects of household characteristics on their participation in ecological restoration programs are provided and analysed, which addresses the study's first objective.

3.2. Research Methods

3.2.1. Conceptual approach

Given the many facets of this research, the core themes of this study are political ecology and sustainable livelihoods. The political ecology idea encompasses the key topics and discussion points linked with the Buffelsdraai Landfill Site Community Restoration Project's (BLSCRP) political response, as well as how this effort tries to address ecological concerns. Political ecology supports complex systems thinking and highlights the drawbacks of defining the natural environment narrowly and treating local and global surroundings as separate entities. The political ecology approach aims to address the interconnections between society and nature, suggesting that the social and environmental dimensions are inextricably linked (Adams and Hutton, 2007). The political ecology framework allows for the investigation of power relations between the local authorities implementing the BLSCRP and the community in which it is implemented (Nkambule, 2017). The various roles performed by the government, non-governmental organizations, as well as local community stakeholders, are critical, as their power dynamics influence perceptions, attitudes, and community project participation.

The sustainable livelihoods framework (SL) conceptualizes many elements that can either constrain or increase existing livelihood options, as well as how these changes interact with and influence one another (Serrat, 2010). When a livelihood can withstand shocks while preserving or developing its capabilities and assets, it is considered sustainable. A livelihood strategy is

made up of several distinct activities (Yobe, 2016). A household could, for example, combine the livelihood activities of crop farming, forest environmental income, and social grants. The SL framework is a people-centred paradigm that places a special emphasis on a community's inherent capabilities and knowledge systems (Tao and Wall, 2009). The community-based conservation (CBC) initiatives such as reforestation aim to enhance livelihoods through asset accrual (Le et al., 2012). Poverty reduction is one of the goals of the BLSCRP, through the Indigenous Trees for Life program (ITFL). The ITFL program involves local community members, referred to as tree-preneurs, in the collecting and growth of tree seedlings, which are then preserved in nurseries and then planted in the buffer zone, to alleviate poverty (Douwes et al., 2015). In this regard, the SL framework was deemed a suitable framework to examine the impacts of the BLSCRP on local community livelihoods.

The evaluation of livelihood impacts, also known as sustainable livelihood approaches, is frequently included in poverty-relieving programs and serves as the foundation for monitoring and evaluation (Friend and Funge-Smith, 2002). Chambers and Conway (1992), introduced the concept of sustainable livelihoods in the context of development and poverty reduction, and it has been widely adopted since then. Worldwide, forest restoration initiatives are becoming more common in many countries. At the community level, forest restoration projects provide a variety of benefits, such as reduced carbon emissions (Sheng et al., 2017), socioeconomic benefits; such as income and employment, the reduction of land management disruptions, and assurances of the effective use of agricultural grasslands (Schirmer and Bull, 2014). Restoring ecological functions brings benefits to rural livelihoods, including improved food and water security, wood resources, and flood and other natural catastrophe protection (Hartman et al., 2016).

Five capitals underlie the livelihood assets in the SL framework and these are defined as natural (N) Financial (F), physical (P), human (H), and social (S) capital. Natural capital alludes to the natural resource stocks that people draw on to make a living and that people have access to, which include land, water, air, and forests (Mazibuko, 2013). Human capital refers to skills, working capacity, knowledge, nutrition, and good health. Healthy living is not merely a means to earning a livelihood, it is also a goal in and of itself. Household size, age, education, health status, and farming experience are all crucial human capital assets for a household’s livelihood (Bazezew et al., 2013). Social capital entails the social resources to make a living, such as ties with more influential and powerful individuals or others like them or memberships in groups or organizations. In general, informal organizations such as religious and self-help groups, as well

as cooperatives that are considered as allowing mechanisms for individuals to seek aid in times of adversity, conflict, and powerlessness are referred to as social capital (Bazezew et al., 2013). Social capital, like human capital, has intrinsic value, and solid social ties are more than just a means to an end. Physical capital also referred to as built capital refers to housing, livestock, machinery, infrastructure, and communications that people have access to (Mazibuko, 2013). Financial capital includes, but is not limited to, income, pension, remittances, and credit (Serrat, 2010). It also considers assets that can be converted into cash, such as livestock (Mazibuko, 2013).

3.2.2. Description of the study area

This study was conducted in two districts of the eThekwini Metropolitan Municipality namely Buffelsdraai and Osindisweni area districts. Figure 3.1 show the map of the study area. According to the 20ll population census, Buffelsdraai has a population of 3078 and comprises 840 households and Osindisweni has a population of 1029 and comprises 234 households. The Buffelsdraai Landfill Site Community Reforestation Project is located about 25 kilometers north of Durban. The site is in an area that has traditionally been used for sugarcane farming, with peri-urban areas to the west, south, and east. The yearly rainfall in Verulam (the nearest town, 5 kilometers east of the project site) is about 766 mm, with most of the rain falling during the summer months. The month with the most rainfall is February, with an average monthly rainfall of 108mm. The average daily temperature in February is 27.4°C, ranging from 22.2°C in the winter to 28.2°C in the summer. The Buffelsdraai Landfill Site Community Project was initiated in 2008 to alleviate climate change impact associated with hosting elements of the 2010 FIFA world cup in Durban.

Figure 3. 1: Map of the study area.

3.2.3. Sampling procedure and sample size

The study utilized a quantitative research methodology, to get an understanding of household perceptions and judgments of their own lived experience in the area. Quantitative research entails numerically representing and manipulating observations to describe and understand the phenomena that they reflect. The sample was drawn by randomly selecting households from local communities in the Buffelsdraai and Osindisweni areas of the eThekwini District and developing the required sample size. This was done under the assumption that the sample acquired is representative of the population. Random sampling is when each unit in the population has an equal probability of being selected into the sample.

3.2.4. Sample size determination

This study used Cochran's sample size formula to calculate the sample size.

The Cochran formula is

$$no = \frac{Z^2 pq}{e^2}$$

Where:

e = is the desired level of precision (at 5% plus or minus precision)

p = is the estimated proportion of the population that has the attribute in question. The assumptions are that 86% of households participate in the ecological restoration project.

q =is 1-p

Z = is the confidence interval at 95% (standard value of 1.96)

$$= \frac{(\mathbf{1.96^2})(\mathbf{0.14})(\mathbf{0.86})}{\mathbf{0.05^2}}$$

$$= \mathbf{185.01} \approx \mathbf{186}$$

So, a random sample of 186 households in the target population should be enough to give the confidence levels required.

Since the population under study is small and known, the sample size calculated in the above formula can be modified using the following equation:

$$n = \frac{no}{1+\frac{no-1}{N}}$$

Here *no* is Cochran's sample size recommendation (186),

N is the population size (total household population of 1074),

and n is the new, adjusted sample size.

The total household population from Buffelsdraai and Osindisweni respectively 840 and 234 as according to the population census 2011 was used as the total population (N) to calculate the required sample size. The study used the total household population, not the total population as it was a household head survey.

$$= \frac{186}{1+\frac{(186-1)}{1074}}$$

$$= 159.67 \approx 160$$

Therefore, the required sample size is 160 households.

3.2.5. Data collection

The study used primary data collected using questionnaires with closed-ended questions. The data was collected from the 26th of May 2022 to the 04th of June 2022. A pre-test of the questionnaire was done on the 24th of May 2022 before the actual collection of the data, a total of ten households were interviewed in the process of the pre-test. The questionnaire was administered by enumerators after being translated into the native language (IsiZulu). The

questionnaire gathered information about the effect of household-level characteristics on their participation in ecological restoration programs.

3.2.6. Data Analysis

The data were analysed quantitatively using STATA and SPSS, using appropriate econometrics models. The primary data was used and analysed using both descriptive and inferential statistics. For household demographics and characteristics frequencies and percentages were used.

3.3. The empirical model

3.3.1. The Multinomial logistic regression model

The study employed multinomial logistic regression (MLR) model to determine the effect of household characteristics on their participation in ecological restoration programs. The predictive potential of household characteristics (socioeconomic and demographic factors) on their participation in ecological restoration programs was examined. An outcome variable was the participation status (e.g., 1 = participating; 2 = not participating but willing to join; 3 = not participating and not willing to join). In contrast to linear regression, which is used to infer continuous variables, logistic regression is employed to estimate any number of discrete classes. The MLR was used to determine the effect of household characteristics on their participation in ecological restoration programs. The use of odds ratios as estimators for the predictor variables in MLR is an advantage of this approach. This gives researchers and practitioners a more natural interpretation of the finished model. The ability to use categorical and continuous independent variables is another advantage of MLR.

The MLR model depicting the likelihood of being in one of the three participating classes as the linear function can be expressed as follows:

$$\ln\left(\frac{Pj}{P1}\right) = \log_e\left(\frac{Pj}{P1}\right) = \beta 0j + \beta 1jX1i + \cdots \beta kjXki + Uji \quad (1)$$

Permitting Pj (j = 1, 2, 3) to be the likelihood of a household being in one of the participating classes assuming that j =1 is the base level.

Where:

- In = the natural logarithm
- β_{kj} = are the regression coefficients to be estimated

- P_1 = the likelihood of the household being in the base level (the household is already participating.
- P_2 = the likelihood that the household is not participating but is willing to join the ecological program
- P_3 = the likelihood that the household is not participating and not willing to join the ecological program
- X_{ki} is the K^{th} explanatory explaining the i^{th} household
- Uji = is the stochastic error term

Equations 2 to 4 estimate the conditional likelihood of the ith household falling into one of the three alternative groups (j = 1, 2, or 3) as a function of the estimated kj and Xki.

$$Pi(j=1) = \frac{1}{1+\exp(\beta 02X2+\beta 12X1i+\ldots+\beta k2XKi)+\exp(\beta 03+\beta 13X1i+\ldots+\beta k3Xki)} \quad (2)$$

$$Pi(j=2) = \frac{\exp(\beta 02X2+\beta 12X1i+\cdots+\beta k2Xki)}{1+\exp(\beta 02X2+\beta 12X1i+\ldots+\beta k2XKi)+\exp(\beta 03+\beta 13X1i+\ldots+\beta k3Xki)} \quad (3)$$

$$Pi(j=3) = \frac{\exp(\beta 03+\beta 13X1i+\cdots+\beta k3Xki)}{1+\exp(\beta 02X2+\beta 12X1i+\ldots+\beta k2XKi)+\exp(\beta 03+\beta 13X1i+\ldots+\beta k3Xki)} \quad (4)$$

3.3.2. The prior expectation of predictor variables used in the multinomial logit model.

Household income, gender, age, marital status, household size, housing tenure, education level, and employment status were used as household characteristics (socioeconomic and demographic) drivers of the dependent participation status. Monthly income has been found to influence an individual's participation in forest management and conservation (Apipoonyanon et al., 2020). The gender of the household has been found to influence household participation decisions (Sharaunga et al., 2012). Females are more likely than males to have a good and pro-social attitude toward community-based forest management (Ray et al., 2017). As a result, a positive influence of gender is expected on participation in the ecological restoration project. The age of the household head was categorized into the following groups, 18 to 35 (Young adults), 36 to 54 (Old adults), and Above 54 (elders). The age of the household head has been found to influence

participation decisions (Atmis et al., 2007). Older people tend to participate in forest management because they rely on natural forests for their livelihoods more than younger people who are involved in all other economic activities (Maskey et al., 2003). As a result, a positive influence of the age of the household head on participation in ecological restoration projects is expected. Households' head marital status has an impact on their participation in forest conservation (Apipoonyanon et al., 2020). Community members who are married are more inclined to help safeguard as well as conserve forests than those who are single (Coulibaly-Lingani et al., 2011). As a result, a positive influence of this variable on ecological restoration project participation is expected.

Household size has been found to influence participation in forest management and conservation (Sserubidde, 2019). A big family implies more available labour, which is frequently used in pursuits like agriculture that provide more consistent revenue, leaving less time for communal forest management (Sserubidde, 2019). Therefore, a positive influence of the household size variable is expected in the ecological restoration project. Participants were asked to categorize their current dwellings into one of the following categories to capture their housing tenure: (1) owned or mortgaged, (2) rented, and (3) other. Participation in forest management and conservation is influenced by educational level (Kura et al., 2021). Household heads with higher levels of education are more likely to engage in participatory forest management initiatives (Kura et al., 2021). Literate individuals are more cognizant than illiterate people of the potential benefits of well-managed forests (Musyoki et al., 2016). Therefore, a positive influence of the educational variable is expected on participation in ecological restoration projects. The employment status of the household head relates to whether the participant is employed full-time, part-time, a student (working full-time or part-time or not), unemployed, and economically inactive groups such as those who were temporarily sick or permanently sick/disabled, retired, or caring for children at home. Employment status has been found to influence household participation in forest management and conservation (Apipoonyanon et al., 2020). A positive influence of the employment status variable is expected on an individual's participation in ecological restoration projects.

3.3.3. Description of the explanatory variables

Table 3.1 below displays the explanatory variables chosen for multinomial logistic regression along with a description of each variable.

Table 3.1: Explanatory variables used in the multinomial logistic regression (MLR) model

Name of the variable	Definition of the variable	Literature
TOT_INCM	The total amount of income in South African Rands receive by household unit monthly	Apipoonyanon et al., 2020
GENDER	The gender of the household head (GENDER=1 if the head is male and 0 otherwise)	Sharaunga et al., 2012; Ray et al., 2017
AGE_HEAD	Age of the household head in years	Atmis et al., 2007; Maskey et al., 2003
MARITAL_STATUS	Marital status of the household head (MARITAL_STATUS=1 if the household is married and 0 otherwise)	Apipoonyanon et al., 2020
HOUSEHOLD_SIZE	The number of household members in a household unit	Sserubidde, 2019
HOUSEHOLD_TENURE	Household dwelling ownership (HOUSEHOLD_TENURE=1 if owned and 0 otherwise	Ray et al., 2017
EDUCATION_LEVEL	Years of formal education by the household head	Kura et al., 2021; Musyoki et al., 2016
EMPLOY_STATUS	Employment status of the household head (EMPLOY_STATUS=1 if household head is employed and 0 otherwise)	Apipoonyanon et al., 2020

3.3.4. Relative Risk Ratios (RRR) of factors influencing household participation in the tree and ecological restoration

A relative risk ratio involves a comparison of two groups in terms of the risk (or likelihood) of a given outcome. In the context of logistic regression, the relative ratios are computed as a risk ratio of the probability of a case falling into the comparison group to the probability of the case belonging to the baseline group, conditioned on the predictors in the model (Osborne, 2015). In general, if an RRR is greater than 1, then this indicates that with an increasing value on the IV there is an increased likelihood/risk of a case falling into the comparison category and decreased risk of falling into the baseline category. If the RRR is less than 1, then this indicates that with

increasing values on the IV there is decreased risk of a case falling into the comparison category and an increased risk of the case falling into the baseline category. If the RRR equals 1, there is no relationship between IV and the risk of falling into the comparison category concerning the baseline group.

3.4. Results

The results of descriptive statistics of household demographics and multinomial logistic regression are presented in this section. For household demographics and characteristics, descriptive statistics such as frequencies and percentages were used. For the factors influencing household participation in the tree and ecological restoration programs, multinomial logistic regression was used.

3.4.1. Key characteristics of the participants

In total, 160, household heads were interviewed from five communities within two areas Buffelsdraai and Osindisweni. A total of 126 household heads were from the Buffelsdraai area, which consists of four communities while 34 household heads were from the Osindisweni area. The interviewed sample was evenly distributed throughout all age and gender groups, except for a minor overrepresentation of women and young adults age groups. To better comprehend the data and to show the demographics of the sample, descriptive statistics were calculated. The population's sociodemographic characteristics were calculated as frequencies, (n) percentages (%), and standard deviations (SD). The indicator and scale frequencies, response percentages, averages, and standard deviations (SD) were determined using descriptive statistics.

The characteristics of the participants are presented in Table 3.2. The participants' key characteristics were calculated as a percentage. The sample was predominantly made up of unemployed household heads (52.5%), female-headed households (57.5%), and unmarried household heads (55.6%). Social grant was the main source of household income (61.9%). Table 3.2 show that 74.4% of the respondents had access to electricity. The majority of the household heads had access to clean water (80.0%). The average length of stay in an area of respondents was 16.4 years (SD = 14.092), with the minimum years of stay being 1 year and maximum years of stay being 78 years.

Table 3.2: Key characteristics of the participants

Characteristics of participants	Osindisweni (%)	Buffelsdraai (%)	Overall sample (%)
Employed household heads	72.2	40.3	47.5
Unemployed household heads	27.8	59.7	52.5
Social grants as the main source of household income	69.4	59.7	61.9
Male-headed households	11.1	51.6	42.5
Female-headed households	88.9	48.4	57.5
Households with access to electricity	83.3	71.8	74.4
Married household heads	55.6	41.1	44.4
Unmarried household heads	44.4	58.9	55.6
Households selling forest products	11.1	11.3	11.3
Households with access to clean water	52.8	87.9	80.0

Source: survey data (2022)

3.4.2. Association between household participation status and household characteristics

A Chi-Square test of independence was conducted for each predictor variable against the outcome variable to test for significant association between the two variables. The Chi-square test of independence determines whether there is an association between categorical variables. The Chi-Square Test of Independence can only compare categorical variables. It cannot make comparisons between continuous variables or between categorical and continuous variables. Additionally, the Chi-Square Test of Independence only assesses associations between categorical variables, and cannot provide any inferences about causation.

Table 3.3 show the cross-tabulation results and the association between household participation and household characteristics. Out of the 160 respondents, 42,5 percent were male-headed households and 57,5 percent were female-headed households. Thus, there were more female-headed than male-headed households due to the de facto household head (e.g., those women acting as household heads because their husband is absent) being considered as household heads.

Therefore, is difficult to tell whether females are more likely to participate than males, for example. For this reason, that is why cross-tabulated data is in percentage form.

Table 3.3: Association between household participation status and household characteristics

	Participating N= 160	**Not participating but willing to participate**	**Not participating and not willing to participate**	**X^2 –p-level**
Gender (%)				0.001
Male	80.0	44.4	0.0	
Female	20.0	55.6	100.0	
Marital Status (%)				0.010
Unmarried	72.5	44.6	61.5	
Married	27.5	55.6	38.5	
Employment status (%)				0.001
Unemployed	62.5	63.0	20.5	
Employed	37.5	37.0	79.5	
Household tenure (%)				0.001
Owned or mortgage	22.5	91.4	92.3	
Rented	77.5	8.6	7.7	
Age (%)				0.001
18 to 35	100.0	34.6	0.0	
36 to 53	0.0	65.4	0.0	
Above 53	0.0	0.0	100	

Source: survey data (2022)

The results show that 80.0% of all participating household heads are males and only 20.0% of all participating household heads are females. The study shows that 44.4% of all not participating but willing to participate household heads are males and 55.6% of all not participating but willing to participate household heads were females. None of all not participating and not willing to participate household heads are males and 100.0% of all not participating and not willing to participate household heads were females. The asymptotic significance for gender is 0.001,

which implies that there is a statistically significant association between participation status and gender at all levels of significance. Therefore, participation status is dependent on gender, *ceteris paribus*.

The results show that 75.5% of all participating household heads were unmarried and 27.5% of all already participating household heads were married. The study results show that 44.4% of all not participating but willing to participate household heads were unmarried and 55.6% of all not participating but willing to participate household heads were married. The study shows that 61.5% of all not participating and not willing to participate household heads were unmarried and 38.5% of all not participating and not willing to participate household heads were married. The asymptotic significance for marital status is 0.010, which implies that there is a statistically significant association between participation status and marital status at all levels of significance. Therefore, participation status is dependent on marital status, *ceteris paribus*.

In the study 62.5% of all participating household heads were unemployed and 37.5% of all already participating household heads were employed. The results show that 63.0% of all not participating but willing to participate household heads were unemployed and 37.0% of all not participating but willing to participate household heads were employed. Table 3.3 shows that 20.5% of all not participating and not willing to participate household heads were unemployed and 79.5% of all not participating and not willing to participate household heads were employed. The asymptotic significance for employment status is 0.001, which implies that there is a statistically significant association between participation status and employment status at all levels of significance. Therefore, participation status is dependent on employment status, *ceteris paribus*.

The results show that 77.5% of all participating household heads live in rented houses and 22.5% of all already participating household heads live in owned or mortgage houses. In the study8.6% of all not participating but willing to participate household heads live in rented houses and 91.4% of all not participating but willing to participate household heads live in owned or mortgage houses. In the study, 7.7% of all not participating and not willing to participate household heads live in rented houses, and 92.3% of all not participating and willing to participate household heads live in owned or mortgage houses. The asymptotic significance for household tenure is 0.001, which implies that there is a statistically significant association between participation status and household tenure at all levels of significance. Therefore, participation status is dependent on household tenure, *ceteris paribus*.

In terms of age, 100.0% of all participating household heads were young adults and none of all already participating household heads were adults and elders, respectively. The results show that 34.6% of all not participating but willing to participate household heads were young adults, 65.4% of all not participating but willing to participate household heads were old adults and none of all not participating but willing to participate household heads were elders. The results show that none of all not participating and not willing to participate household heads were young adults and old adults, respectively, and 100.0% of not participating and not willing to participate household heads were elders. The asymptotic significance for age is 0.001, which implies that there is a statistically significant association between participation status and the age of household heads at all levels of significance. Therefore, participation status is dependent on the age of household heads, *ceteris paribus*.

3.4.3. Individual association for key continuous variables influencing household participation status.

The results of One-Way ANOVA for continuous variables influencing household participation status are presented in Table 3.4 below. The One-Way ANOVA was used to determine whether there are any statistically significant differences between the means of the independent groups.

Total monthly income (TotalMonthlyIncome), and Years of education (YearsOfEducation) variables were found to have a statistical significance individual association with the outcome variable, household participation status. The test of homogeneity of variance was not violated for variables for total monthly income and years of education variable. Since this assumption was not violated ANOVA table was used for the statistical significance of the total monthly income and years of education variable.

Table 3.4: Factors influencing household participation status.

Explanatory variables	N	Mean	SD	F. Sig.
TotalMonthlyIncome				
Already Participating	40	2.35	0.700	0.001
Not participating but willing to participate	81	1.67	0.775	
Not participating and not willing to participate	39	1.54	0.756	
Total	160	1.81	0.813	

YearsOfEducation				
Already Participating	40	2.17	0.385	0.001
Not participating but willing to participate	81	2.23	0.455	
Not participating and not willing to participate	39	1.00	0.000	
Total	160	1.92	0.644	
HouseholdSize				
Already Participating	40	1.23	0.480	0.485
Not participating but willing to participate	81	1.33	0.548	
Not participating and not willing to participate	39	1.36	0.584	
Total	160	1.31	0.540	

Source: survey data (2022)

3.4.4. Diagnostics to assess the degree of multicollinearity

The Variance Inflation Factor (VIF) measures the severity of multicollinearity in regression analysis. Multicollinearity is when there is a correlation between predictors (explanatory variables) in a model. The VIF estimates how much the variance of a regression coefficient is inflated due to multicollinearity. The variance inflation factors range from 1 upwards. A rule of thumb for interpreting the variance inflation factor: 1 being not correlated, between 1 and 5 moderately correlated, and greater than 5 being highly correlated. Table 3.5 show the VIF test results proved that there is no multicollinearity problem between the predictor variables.

Table 3.5: Diagnostics to assess the degree of multicollinearity

Variable	**VIF**	**1/VIF**
Age	2.64	0.379
Year of Education	1.66	0.603
Gender	1.56	0.639
Household Tenure	1.34	0.749
Employment Status	1.30	0.770
Total Monthly Income	1.25	0.802

Marital Status	1.09	0.914
Mean VIF	1.55	

Source: survey data (2022)

3.4.5. The Bruesch-Pagan / Cook-Weisberg test for heteroscedasticity

The Bruesch-Pagan/Cook-Weisberg test was used to check for heteroscedasticity. The sample size of 160 households was regarded as being large because it was more than 40. The coefficient estimates for all three models were deemed fair and consistent after the heteroscedasticity correction (Gujarati and Porter, 2009).

3.4.6. Model fitting Information for the multinomial logistic regression model

The model fitting information results for the generalized ordinal logistic regression model. Intercept Only refers to a model that merely fits an intercept to predict the result variable without adjusting for any predictor factors. A model is referred to as final if it contains the requisite predictor variables and its coefficient was calculated through an iterative process that maximized the log-likelihood of the result. The chi-square statistic was used to test whether the improvement is statistically significant, with p-values less than 0.05 suggesting model fit. Model fit was evaluated by comparing the 2-log likelihood for the intercept-only model to the full model.

The −2 log-likelihood was computed for the intercept-only model, or the model without any independent variables, and the final model with all independent variables. The −2 log-likelihoods for each were subtracted from one another to produce the chi-square (317.682 – 39.731 = 277.951). A greater amount of change between the two models suggests a greater improvement in model fit. Significance at less than 0.05 suggests good model fit. Here the final model was significantly different from the intercept-only model (p <0 .001). Thus, the independent variables, as a group, contribute significantly to the prediction of the outcome.

3.4.7. The effect size of the multinomial logistic regression model

The three different pseudo-R-Squared summary statistics were used to assess the model fit by determining the effect size of the model. There is disagreement on the use of the pseudo-R^2; Petrucci (2009), suggests that it approximates the same variance interpretation as R^2 in linear regression (meaning accounting for the amount of explained variance in the outcome variable), and Hosmer and Lemeshow (2000), recommend using it for model building only. It is instructive

nonetheless to become familiar with the three commonly included pseudo-R^2 statistics. All of the pseudo-R^2 statistics are typically much lower than the R^2 statistics in linear regression. McFadden's is a transformation of the likelihood ratio statistic. It is computed by dividing the following:

$$\frac{1-(\,ratio\ of\ loglikelihood\ of\ the\ null\ model)}{(the\log likehood\ of\ the\ constant\ model\ only)}$$

Values from 0.2 to 0.4 for McFadden are considered "highly satisfactory" (Petrucci, 2009). The Cox and Snell pseudo-R^2 is also based on the log-likelihoods and considers sample size, but it cannot achieve a maximum value of 1. Nagelkerke pseudo-R^2 adjusts Cox and Snell so that a value of 1 is possible.

For this analysis, pseudo-R^2 statistics were as follows: Cox and Snell, 0.824; Nagelkerke, 0.943; and McFadden, 0.839 as presented in table 3.10. Since the value of Cox and Snell pseudo-R^2 is less than 1 it means the model predict well and the high value of Nagelkerke means the higher fitness of the predictive model. Based on McFadden's Pseudo R-square we can infer that the full model containing predictor variables represents an 83.9% improvement in fit relative to the null model. Therefore, the Pseudo R-square for the model is considered to be high.

3.5. Factors influencing household participation in the tree and ecological restoration

Table 3.6: show the results obtained using the multinomial logistic regression. The first contrast of the results of the model allows us to determine which of the independent variables significantly predict the probability of a person falling in participating category versus the not participating but willing to participate category, conditional on the predictors. The results depict that the statistically significant factors influencing household participation in the tree and ecological restoration were gender, age, total monthly income, and household tenure. The employment status, marital status, and educational level did not significantly influence the respondent's participation.

Table 3.6: Factors influencing participation in a tree and ecological restoration

Explanatory Variable	RRR	Coefficient	Standard error	Z	Sig
Gender					
Male	9.944	2.297	1.060	2.17	0.030

Age	3.723	-21.71	1.427	-15.22	0.000
EmploymentStatus					
Employed	0.287	-1.248	1.038	-1.20	0.229
MaritalStatus					
Married	0.294	-1.224	1.073	-1.14	0.254
TotalMonthlyIncome	3.435	1.234	0.697	1.77	0.077
YearOfEducation	0.540	-0.616	0.578	-1.07	0.287
HouseholdTenure					
Owned or Mortgage	0.003	-5.789	1.478	-3.92	0.000
Cons	2.945	24.104	2.924	8.24	0.000
Not participating but willing to participate				**(base outcome)**	
Gender					
Male	1.357	0.305	0.369	0.83	0.408
Age	3.821	19.761	0.534	37.02	0.000
EmploymentStatus					
Employed	0.675	0.037	0.289	0.13	0.899
MaritalStatus					
Married	1.037	-0.393	0.284	-1.39	0.166
TotalMonthlyIncome	1.261	0.232	0.179	1.30	0.195
YearOfEducation	3.880	-21.669	0.582	-37.25	0.000
HouseholdTenure					
Owned or Mortgage	3.014	1.103	0.438	2.52	0.012
Cons	1.571	-17.968	2.149	-8.36	0.000

Source: Survey data (2022)

Gender: The household gender was statistically significant at 5% and 10% levels of significance and positively related to the probability of a household head falling in the participating category in tree and ecological restoration projects. This implied that the log odds of being in the already participating category relative to not participating but willing to participate category for males is predicted to be 2.297 points greater than for females. The positive slope suggests that males have a greater possibility of participating and a lower possibility of not participating but are willing to participate in community-based tree and ecological restoration projects. This implies that

different genders react differently to such projects. This study's results show that male household heads are expected to participate more than women in a tree and ecological restoration project. This result is contrary to Ray et al. (2017), who found females to be more likely to have a good and pro-social attitude toward community-based forest management. Discriminatory gender norms and practices, exclusionary institutions, and persistent information asymmetries among other factors, may all limit women's ability to participate and their willingness to participate in such a project.

Age: The household age was statistically significant at all levels of significance and negatively related to the probability of a household head already participating in the tree and ecological restoration projects. This implies that with a one-year increase in household head age, the log odds of falling into the already participating category relative to the not participating but willing to participate category is predicted to decrease by -21.711 units. This result suggests older household heads are less likely to participate in a community-based tree and ecological restoration project compared to young ones. This observation is realistic because older people tend to be weak and have many health issues which reduced their ability and willingness to participate in such projects. However, this result conflicts with findings by Maskey et al. (2003), who found that older people tend to participate in forest management because they rely on the natural forest for their livelihood more than younger people who are involved in diverse economic activities.

Total Monthly Income: The household total monthly income was statistically significant at a 10% level of significance and positively related to the probability of household heads falling in the already participating category. This implies that one-rand increase in household head total monthly income, the log adds of falling into the already participating category relative to the not participating but willing to participate category is predicted to increase by 1.234 unity. This implies that high-income earners are more likely to participate in a community-based tree and ecological restoration projects. This is in line with previous findings by Agrawal (2000), and Apiponyanon et al. (2020**)**.

Household Tenure: The household tenure variable was statistically significant at all levels of significance and negatively related to the probability of a household falling into the already participating category in the tree and ecological restoration project. This implies that the log odds of being the already participating category relative to the not participating but willing to participate category for household heading living in owned or mortgage houses are predicted to

be 5.789 points less than that for household heads living in rented houses. The negative slope suggests that household heads living in owned or mortgage houses are less likely to participate and are more like to not participate but willing to participate in a community-based tree and ecological restoration projects.

The second contrast of the results of the model allows us to determine which of the independent variables significantly predict the probability of a person falling into the not participating and not willing to participate category versus the not participating but willing to participate category, conditional on the predictors. The results depict that the statistical significance factors influencing households not participating and not willing to participate in the tree and ecological restoration were age, educational level, and household tenure. The gender, employment status, marital status, and total monthly income did not significantly influence respondent's not participating and not being willing to participate in a community-based tree and ecological restoration project.

Age: The household age was statistically significant at all levels of significance and positively related to the probability of a household head not participating and not willing to participate in the tree and ecological restoration projects. This implies that with a one-year increase in household head age, the log odds of falling into the not participating and not willing to participate category relative to the not participating but willing to participate category is predicted to increase by 19.761. This result suggests older household heads are less likely to participate in a community-based tree and ecological restoration project compared to young ones.

Educational level: The household head's educational level was statistically significant and negatively related to the probability of a household head not participating and not willing to participate in the tree and ecological restoration. This implies that with a one-year increase in household head educational level, the log odds of falling into the not participating and not willing to participate category relative to the not participating but willing to participate category is predicted to decrease by 21.669. This result suggests that highly educated household heads are more like participate in a community-based tree and ecological restoration project compared to the less educated. This result is in line with Kura et al. (2021), who found households with higher levels of education are more likely to engage in participatory forest management initiatives, and also in line with Musyoki et al. (2016), who found that literate individuals are more cognizant than illiterate people of the potential benefits of a well-managed forest.

Household Tenure: The household tenure variable was statistically significant at 5% and 10% levels of significance and positively related to the probability of a household not participating and not willing to participate in the tree and ecological restoration project. This implies that the log odds of being in the not participating and not willing to participate category relative to the not participating but willing to participate category for household heading living in owned or mortgage houses are predicted to be 1.103 points more than that for household heads living in rented houses. The positive slope suggests that household heads living in owned or mortgage houses are more likely to not participate and not willing to participate and are less likely to not participate but willing to participate in a community-based tree and ecological restoration projects.

3.6. The Relative Risk Ratios (RRR) of factors influencing household participation in the tree and ecological restoration.

The relative risk ratio in the above table (Table 3.6, first column) represents the predicted multiplicative change in the relative risk (that is the risk of falling into a comparison group relative to falling into the baseline group) per unit increase on an independent variable. The RRR for Gender (Male) indicates that the relative risk for persons identified as male is 9.943 times that of females. This means that males are more likely to fall into the already participating category and less likely to fall into the not participating but willing to participate category. For females, this picture is reversed.

The RRR for Age indicates that for each one-year increase in this variable, the risk of falling into the already participating category relative to the likelihood of falling into the not participating but willing to participate category is predicted to change by a factor of 3.723. This means that as age increases the likelihood of falling into the already participating category is predicted to increase while the likelihood of falling into the not participate but willing to participate category is expected to decrease.

The RRR for employment status(employed) indicates the relative risk for persons employed is 0.287 times that of the unemployed. This means that employed people are more likely to fall into the already participating category and less likely to fall into the not participating but willing to participate category. For the unemployed, this picture is reversed.

The RRR for marital status(married) indicates the relative risk for persons married is 0.294 times that of unmarried. This means that married people are more likely to fall into the already

participating category and less likely to fall into the not participating but willing to participate category. For unmarried, this picture is reversed.

The RRR for total monthly income indicates that for each one-rand increase on this variable, the risk of falling into the already participating category relative to the likelihood of falling into the not participating but willing to participate category is predicted to change by a factor of 3.434. This means that as total monthly income increases the likelihood of falling into the already participating category is predicted to increase while the likelihood of falling into the not participate but willing to participate category is expected to decrease.

The RRR for educational level indicates that for each one-year increase in this variable, the risk of falling into the already participating category relative to the likelihood of falling into the not participating but willing to participate category is predicted to change by a factor of 0.540. This means that as educational level increases the likelihood of falling into the already participating category is predicted to decrease while the likelihood of falling into the not participate but willing to participate category is expected to increase.

The RRR for household tenure (owned or mortgage) indicate that the relative risk for persons living in owned or mortgaged house is 0.003 times that of living in a rented house. This means that households that own or mortgage a house are more likely to fall into the already participating category and less likely to fall into the not participating but willing to participate category. For persons living in a rented house, this picture is reversed.

3.7. Discussion

In evaluating factors influencing household participation status, socioeconomic and household characteristics are important. This study attempted to explore factors influencing household participation in the tree and ecological restoration in the eThekwini district of KwaZulu Natal province, South Africa. Statistical results indicated that predictor variables such as age, years of education, and household tenure were strong predictors of household participation in the tree and ecological restoration. Gender was a moderate predictor and total monthly income was an average predictor of household participation in the tree and ecological restoration. These findings should be interpreted cautiously since they could have been impacted by other latent variables unrelated to respondents' opinions about how they relate to the social and natural environment as a whole. They do, however, provide insight into some of the socio-demographic variables that affect how people and nature interact in a socio-demographically varied region like South Africa's eThekwini district. The findings are examined concerning pertinent literature.

Gender has been widely studied in the discussion of socioeconomic factors and household demographic characteristics influencing household participation status (Sharaunga, 2012; Giri, 2009). In this study gender was a moderate predictor of household participation status. The parameter estimate of the gender of the household head was positive and statically significant at 5% and 10% in the first contrast. This implies that male-headed households were more likely to be in the already participating and willing to participate category than being in the non-participating categories (i.e., 'not participating but willing to participate and 'not participating and not willing to participate). Thus, male-headed households were more likely to participate in the tree and ecological restoration project than female-headed households, *ceteris paribus*. These results are contrary to findings by Sharaunga (2012), who found female-headed households to be more likely to participate in CBFM than male-headed households. However, this was in the context of CBFM, not the tree and ecological restoration. The reason for more women participation was cited to be females see the forest as means of meeting basic needs and a support mechanism for increasing self-reliance, while men are likely to view the forest as a source of income. Studies conducted in Nepal have reported more participation of males than females in CBFM (Giri, 2009). The reason cited was gender disparity in decision-making power in most households harmed the participation of women (Maskey et al., 2006). In the context of the tree and ecological restoration, there is scant research on gender as a predictor of household participation status.

Age was a strong predictor of household participation in the tree and ecological restoration project. The estimated coefficients for the age of household head were statically significant in both contrasts, negative in the first contrast and positive in the second contrast. This means that young household heads were more like to be in the not participating and willing to participate category than in the already participating category as age increases. This implies that young household heads were more likely to participate in tree and ecological restoration projects than elder ones, *ceteris paribus*. This observation is realistic because older people tend to be weak and have many health issues which reduced their ability and willingness to participate in such projects. However, these finds are inconsistent with previous research findings. Maskey et al. (2003), in Nepal, found that older tend to participate more in community forestry programs than young people. This was linked to the fact that older people participate in CBFM programs at a reduced opportunity cost because they are retired. Sharaunga, (2012), in South Africa found that older household heads were more likely to participate in CBFM. This was attributed to the fact that older household heads had limited opportunities to be employed in towns and cities than

young household heads. According to Dolisca et al. (2006), in Haiti, younger people were eager to participate in and contribute to the process of decision-making influencing forestry initiatives, and elderly people were primarily interested in gathering forest resources.

In the study communities, household participation in the tree and ecological restoration project was also influenced by the total monthly income of a household. The estimated coefficient for total monthly income was positive and significant in the first contrast. This indicates that a household was more likely to be in the already participate category than in the not participating and not willing to participate category as total monthly income increases, *ceteris paribus*. The results of this study are consistent with previous research findings (Apiponyanon et al., 2020) observed that households with higher income levels are more likely to participate in environmental development projects, and these findings are supported by the findings of this study. They also concur with research by Agrawal and Gupta (2005), and Behera and Engel (2004), which revealed that those who are more prosperous on an economic and social level are more likely to participate in community-level user groups. They explained that poor households lack participation as being due to the high opportunity cost of participation since the time spent participating could have been used to work for cash. However, findings by Sharaunga (2012), differed from these results who found low-income households to be more likely to participate in community environment programs than high-income households. This was attributed to the fact that low-income households had low levels of education and a low level of environmental awareness.

Household tenure was a strong determinant of household participation in tree and ecological restoration projects. The estimated coefficients for household tenure were statically significant in both contrasts, negative in the first contrast and positive in the second contrast. This indicates that a household living owned or mortgaged house was more likely to be in the non-participating categories (i.e., 'not participating but willing to participate' and 'not participating and not willing to participate') than being in the already participating category. Thus, households living in rented houses were more likely to participate than households living in owned or mortgage houses, ceteris paribus. Household tenure has received little to no attention in the discourse of socioeconomic factors and demographic factors influencing household participation in tree and ecological restoration. This is an angle that requires further research as international literature on age as a predictor variable of household participation status is scant.

Years of education were a strong determinant of household participation in the tree and ecological restoration project. The estimated coefficient for years of education was positive and statistically significant at all levels of significance in the second contrast. This means that households with a high level of education were less likely to be in the non-participating categories (i.e., 'not participating but willing to participate' and not participating and not willing to participate) than the already participating category. This implies that households with a high level of education are more likely to participate in tree and ecological restoration projects than households with low levels of education, *ceteris paribus*. This result is realistic that households with high education can easily obtain information about ecological restoration benefits compared to non-educated households. This result is consistent with the findings by Kura et al. (2021), who found that households with higher levels of education are more likely to engage in participatory forest management initiatives. This is can be attributed to the fact that literate individuals are more cognizant than illiterate people of the potential benefits of well-managed forests (Musyoki et al., 2016). This finding is also corroborated by Adhikari et al. (2014), who found that as formal education levels rise, so does the desire of forest users to participate in management operations.

3.8. Conclusion

Demographic and socio-economic aspects all have an impact on the participation of local communities in the tree and ecological restoration projects. These important variables may promote or deter local communities from taking part in ecological restoration programs. Socioeconomic and demographic factors that comprise, age, gender, total monthly income years of education, and household tenure were the main factors influencing household participation in the tree and ecological restoration projection. Notably, marital status and employment status were not significantly associated with household participation in the tree and ecological restoration project.

Based on these findings, the following policy recommendation and interventions are made. The socioeconomic and demographic elements, which were very important in the research area, should be incorporated into the national, provincial, district and local municipality policy frameworks on ecological restoration projects. These factors could encourage local people's involvement in ecological restoration projects if they are thoughtfully incorporated into policy formation. Strong local community participation in the tree and ecological restoration programs and positive local community associations with the forests are essential for forest conservation and ensuring the long-term viability of the forest. The local community needs to be consistently

encouraged for the tree and ecological restoration project to succeed. Incentives should be raised, access to potential sponsors should be improved, social group formation encouraged, and infrastructures should be improved to do this.

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CHAPTER 4: THE DETERMINANTS OF HOUSEHOLD'S PERCEPTIONS OF TREES IN THEIR ENVIRONMENT: A CASE STUDY OF ETHEKWINI DISTRICT KWAZULU NATAL PROVINCE, SOUTH AFRICA

Abstract

Environmental perception is a crucial topic of study. The concern for the environment is expanding as a result of increased environmental damage brought on by human activity. Without knowing how people perceive the environment, effective environmental management cannot be achieved. Interactions between people and nature are frequently influenced by their beliefs, perceptions, and environmental concerns. Understanding how environmental perceptions are formed and where knowledge about the environment originates is crucial if human behaviour toward the environment is to be modified. Hence this study has explored socioeconomic factors and household demographic characteristics that may significantly determine households' perceptions of trees in their environment.

Primary data on socioeconomic factors and household demographic characteristics were collected from 160 household heads. Descriptive statistics such as cross tabulation, percentages, frequencies, and chi-square were utilized to describe household and community characteristics. Kruskal-Wallis H test was used to assess the individual association between predictor variables and the outcome variable. Ordinal logistic regression was utilized to determine the socioeconomic factors and household demographic characteristics influencing households' perceptions towards trees in their environment. The results showed that socioeconomic factors and household demographic characteristics such as age ($p<0.001$), gender ($p<0.020$), marital status ($p<0.023$), and dwelling type ($p<0.007$) were significant predictors of households' perceptions of trees in their environment. Employment status, level of education, access to electricity, and access to clean water were found insignificant.

Keywords: Environmental perceptions, environmental concern, socioeconomic factors, and household demographic characteristics.

4.1. Introduction

Environmental perceptions are reflected in how a person observes, assesses, and understands environmental issues as well as in household attitudes towards the environment. These perceptions are formed by people's attitudes and understandings, which reflect their traditional way of life and common values (Shaoa and Lui, 2017). People's perceptions of their environment

are heavily influenced by socioeconomic and demographic factors. While environmental concerns refer to the effect or feeling connected with environmental issues like environmental quality, accessibility, and availability of resources (Schultz et al., 2005). Therefore, environmental concerns are distinct from broader environmental perspectives.

Environmental perceptions have a big influence on how people act in the world (Bennett et al., 2017). As a result, if environmental views are not well understood, effective environmental management will be impossible (Beardmore, 2015). People's attitudes and perceptions regarding environmental issues and activities are founded on complex moral and social values (Clayton and Myers, 2015), which include beliefs, affective responses, and behavioural intentions. Thus, understanding the factors that influence environmental perceptions can also help us better comprehend pro-environmental behaviour and improve effective ecosystem restoration and management strategies. People, on the other hand, do not all share the same environmental perceptions, making it difficult to generalize environmental behaviour patterns within as well as between societies. Environmental attitudes and the importance of environmental protection are socioeconomically, politically, and culturally determined, as seen by the differences in the perceived importance of environmental concerns in various places (Dlamini et al., 2020).

The empirical findings regarding the determinants of households' perceptions of trees in their environment are presented and discussed in this chapter, addressing the study's second objective.

4.2. Research methods

4.2.1. Data

As described in chapter 3, data for this chapter included 160 randomly selected household heads from two districts of KwaZulu Natal Province. The relevant questionnaire module for this chapter included information on household heads' demographics and socioeconomic characteristics such as age, gender, marital status, employment status, level of education, access to clean water, and access to electricity. Also relevant measures of household perceptions of trees in their environment.

4.2.2. Analytical model

An ordinal logistic regression model evaluated the factors influencing households' perceptions of trees in their environment.

4.3. The Empirical Models

4.3.1. An Ordinal Logistic Regression Model

The study employed an ordinal logistic regression (OLR) model to investigate the determinants of households' perceptions of trees in their environments. The predictive potential of socioeconomic factors on household perceptions of trees in their environment was examined. A dependent (response) variable on whether households perceived any improvement or deterioration in regulating ecosystem services (air quality, flood control, and soil protection) in their environment due to the planting of trees, was chosen to measure households' perceptions of trees in their environment. Forests and trees provide secondary advantages that sustain livelihoods while also reducing erosion and regulating air quality (Foli et al., 2014; Reed et al., 2017). Erosion and flood control are the major regulating ecosystem services provided by the forest ecosystem (Chettri et al., 2021). The variable was assessed using a three-point Likert scale: improvement, no change, and deterioration. Household income, gender, marital status, age, education level, dwelling type, employment status, access to electricity, length of stay in an area, and access to facilities were chosen as socioeconomic and demographic drivers of the dependent environmental perception responses. Researchers studying the impact of socioeconomic on environmental perceptions and attitudes have utilized similar measures of human-nature relationships (Dlamini et al., 2020; Beiser-McGrath and Huber, 2018; Jones et al., 2015). In the South African setting, where substantial disparities prevail in the provision of such services at a spatial level, dwelling type and electricity availability were added as factors since they have an economic bearing. Participants were asked what their estimated total monthly income is. Income level has been found to influence environmental perceptions and attitudes (Dlamini et al., 2020). A positive link is expected between income level and a household's environmental perceptions. Gender has been extensively researched as a factor influencing environmental perceptions and attitudes (Dlamini et al., 2021), with females being more predisposed to environmental protection than males (Zelezny et al., 2000).

4.3.2. A prior expectation of the predictor variable utilized in ordinal logistic regression

The age of the household has been associated with environmental perceptions and attitudes (Dlamini et al., 2020). A negative relationship between a household's environmental perceptions

and the age of the household is expected. Ramkissoon et al. (2013), examined a wide variety of American studies on environmental concerns found a negative correlation between environmental attitudes and perceptions as people get older. Even though these studies have found a negative link between age and environmental sentiments, it is more typical to establish a link between age and pro-environmental behaviour (Krettenauer, 2017). Environmental perceptions and attitudes are said to be influenced by the education level of the household (Dlamini et al., 2020). It is expected that education will have a positive impact on environmental perceptions. Dwelling type has been found to impact environmental perceptions and attitudes (Dlamini et al., 2020). Dwelling type is associated with a socioeconomic level in South Africa, as well as in other regions of the world (Jones et al., 2015). A positive link between households living in formal dwellings and environmental perceptions is expected. Employment status relates to whether the participant is employed full-time, part-time, a student (working full-time or part-time or not), unemployed, and economically inactive groups such as those who were temporarily sick or permanently sick/disabled, retired, or caring for children at home. The employment status of the household head has been found to influence environmental perceptions and attitudes (Dlamini et al., 2020). A positive relationship between full-employed households and environmental perceptions is expected. Electricity has been associated with environmental perceptions (Dlamini et al., 2020). A positive link between the availability of electricity and environmental perceptions is expected.

Length of stay in an area has been found to influence environmental perceptions and attitudes (Dlamini et al., 2020). Place bonding results in particular environmental behaviours, which are influenced by environmental perceptions and attitudes, hence the length of stay and immigration status have been connected to environmental perceptions and attitudes (Dlamini et al., 2021). Therefore, we expect a positive influence of the length of stay in an area variable on environmental perceptions. Access to facilities has been associated with environmental perceptions and attitudes (Dlamini et al., 2020). Access to amenities such as water and waste disposal facilities in urban areas could result in people developing specific environmental perceptions and attitudes, as behaviours and awareness of water pollution and waste disposal result in some level of environmental awareness, particularly in developing countries (Dlamini et al., 2020). Thus, a positive link between the access to facilities variable and environmental perceptions is expected.

The analysis was conducted to determine if households' perceptions of trees in their environment are associated with socioeconomic factors. Since the dependent variable (household perceptions) has more than two categories, the analysis can be done using the ordinal logistic regression model, often known as the proportional odds (PO) model. One of the most fundamental assumptions of the PO model is that each level of the dependent variables must have the same relationship with the explanatory variables, the ordinal logistic regression model can be expressed as follows for an ordinal dependent variable with M categories:

$$p(Yi > j) = \frac{exp(\alpha+\beta jXi)}{1+[exp(\alpha+\beta jxi)]},\ j = 1.2.3 \ldots M-1$$

Where:

J -is the cumulative logit,

βj -is a vector of regression coefficients,

Xi is a p1 vector that contains all of the explanatory variables.

4.3.3. Bivariate analysis: association between outcome and explanatory variables

The bivariate analysis involves the analysis of two variables (often denoted as X, and Y) to determine the empirical relationship between them. The analysis was conducted to determine if households' perceptions of trees in their environment were associated with the explanatory variables. A nonparametric test, the Kruskal-Wallis H test was utilized.

4.3.4. Description of explanatory variables

Table 4.1 displays explanatory variables chosen for the generalized ordered logistic regression (GORL) along with a description of each variable.

Table 4.1: Explanatory variables used in the Ordinal Logistic regression (OLR) model

Variable name	Description of the variable	Literature
HOUSEHOLD_INCOME	The total amount of income in South African rands receive by household unit monthly	Ramkissoon et al., 2013

GENDER	The gender of the household head (GENDER=1 if the head is male and 0 otherwise)	Dlamini et al., 2021 Zelezny et al., 2000
AGE	Age of the household head in years	Dlamini et al., 2020; Krettenauer, 2017
EDUCATION_LEVEL	Years of formal schooling by the household head	Dlamini et al., 2020;
HOUSEHOLD_TENURE	Household dwelling ownership (HOUSEHOLD_TENURE=1 if owned and 0 otherwise)	Dlamini et al., 2020; Jones et al., 2015
EMPLOYMENT_STATUS	Employment status of the household head (EMPLOYMENT_STATUS = if the household head is employed and 0 otherwise)	Dlamini et al., 2020
ACCESS_ELECTRICITY	Whether the household unity has access to electricity (ACCESS_ELECTRICITY =1 if the household has access to electricity and 0 otherwise)	Dlamini et al., 2020 Dlamini et al., 2021
LENGTH_STAY	Length of stay in an area of the household unity in years	Dlamini et al., 2020
ACCESS_FACILITIES	Whether the household unity has success to clean water or not (ACESS_FACILITIES = 1 if the household unity has access to clean water and 0 otherwise)	Dlamini et al 2020

4.4. Results

The results of descriptive statistics of household demographics and ordinal logistic regression are presented in this section. For household demographics and characteristics, descriptive statistics such as frequencies and percentages were used. For the determinants of households' perceptions of trees in their environment ordinal logistic regression was used.

4.4.1. Socio-demographic profile of the sample of participants

In total, 160, adults were interviewed from five communities within two areas Buffelsdraai and Osindisweni, and completed the survey. A total of 126 adults were from the Buffelsdraai area, which consists of four communities while 34 adults were from the Osindisweni area. The interviewed sample is evenly distributed throughout all age and gender groups, except for a minor overrepresentation of women and young adults age groups. To better comprehend the data and to show the demographics of the sample, descriptive statistics were calculated. The population's sociodemographic characteristics were calculated as frequencies, (n) percentages (%), and standard deviations (SD). The indicator and scale frequencies, response percentages, averages, and standard deviations (SD) were determined using descriptive statistics.

The sample was predominantly made up of female (57.5%), young adults (42.5%), and unemployed (52.5%) household heads. Most household heads (74.4%) had access to electricity, access to clean water (80%) and had secondary high school education (58.1%). The average length of stay in an area of respondents was 16.4 years of stay (SD = 14.092), with the minimum years of stay being 1 year and maximum years of stay being 78 years. The socio-demographic profile of the sample can be seen in Table 4.2.

Table 4.2: Socio-demographic profile of the sample of participants

Characteristics of participants	Osindisweni (%)	Buffelsdraai (%)	Overall sample (%)
Employed household heads	72.2	40.3	47.5
Social grants as the main source of household income	69.4	59.7	61.9

Households headed: Male	11.1	51.6	42.5
Female	88.9	48.4	57.5
Households with access to electricity	83.3	71.8	74.4
Married household heads	55.6	41.1	44.4
Households selling forest products	11.1	11.3	11.3
Households with access to clean water	52.8	87.9	80.0

Source: Survey data (2022)

4.4.2. Analysing the relationship between explanatory variables

Table 4.3 display the spearman correlation results between explanatory variables. An analysis of the explanatory variable was made using Spearman's correlation to determine their association. The Spearman correlation is useful for feature selection, identifying variables that are highly correlated and only keeping one of them so that the model can have as much predictive power using few variables as possible The Spearman correlation coefficient is usually adopted when it is assumed that the data is not normally distributed and that there is no association between the explanatory variables (Artusi et al., 2002). The correlation coefficient ranges from +1 to -1. A correlation coefficient of +1 indicates a perfect association of variables, a correlation of zero indicates no association between variables and a correlation of -1 indicates a perfect negative association of variables. The closer the correlation is to zero, the weaker the association between the variables (Artusi et al., 2002).

Table 4.3: The Spearman correlation between explanatory variables.

Variable	Gender	Age	Employment Status	Total Income	Year of education	Dwelling type	Access to electricity	Length of stay	Access to clean water
Gender	1.0000								
Age	-0.5798	1.0000							
Employment status	-0.2101	0.3648	1.0000						
Total Income	0.2617	-0.3125	0.1342	1.000					
Year of education	0.3594	-0.5907	-0.3330	0.1342	1.0000				
Dwelling type	-0.0091	-0.1757	-0.0929	-0.0268	0.0613	1.000			
Access to electricity	-0.0702	-0.1440	-0.0710	-0.0797	0.1541	0.9180	1.0000		
Length of stay	-0.0388	0.0450	-0.0994	-0.0473	-0.0414	0.0251	0.0026	1.0000	
Access to facilities	-0.1138	0.3347	0.1815	-0.2563	0.0088	-0.1197	0.0286	0.0838	1.0000

Source: Survey data (2022)

4.4.3. Association between household perception and socio-demographic factors

To ascertain if the household perception of tree variables is independent of socio-demographic parameters, the relationship between the two was examined. Non-parametric tests of independence were chosen since an initial analysis of the data's nature revealed that the data were not normally distributed, indicating that parametric statistical tests were not appropriate. The Kruskal-Wallis tests were specifically employed. For instance, the Kruskal Wallis was used to ascertain whether the job level of households affected how they perceived the presence of trees in their surroundings. All dependent and independent variables listed in Table 4.4 underwent the same evaluation.

The Kruskal-Wallis H test (sometimes also called the "one-way ANOVA on ranks") is a rank-based nonparametric test that can be used to determine if there are statistically significant differences between two or more groups of an independent variable on a continuous or ordinal dependent variable. It is considered the nonparametric alternative to the one-way ANOVA, and an extension of the Mann-Whitney U test to allow the comparison of more than two independent groups.

Table 4.4: Results of the Kruskal-Wallis H test

Variables (Household Perception)	**Kruskal –Wallis H**	**Asymp. Sig.**
Gender	6.554	0.038
Age	19.188	0.001
Marital status	12.246	0.002
Employment Status	23.511	0.001
Total Income	2.957	0.228
Level of Education	12.125	0.001
Dwelling type	25.775	0.001
Access to clean water	24.841	0.001
Length of stay	0.481	0.786
Access to electricity	20.448	0.001

Source: Survey data (2022)

A Kruskal-Wallis H test showed that there is a statistically significant difference between the three groups of household perceptions for gender, age, marital status, employment status, level of education, dwelling type, access to clean water, and access to electricity variables. Only total income and length of stay did not have a significant association with households' perceptions of trees. For variables, total income and length of stay, the Kruskal-Wallis H test showed that there is no statistically significant difference between the three groups of household perceptions. Therefore, the Post-hoc Mann Whitney U test was used in comparing pairs of groups to identify the exact groups that differ. The results of the Post-hoc Mann Whitney U test are displayed in Table 4.5.

Table 4.5: Results of Post-Hoc Whitney U test

Groups	Variables	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig
Improvement and No change	Length of stay	1773.500	3151.500	-0.529	0.597
	Total income	1822.000	4450.000	-0.274	0.784
Deterioration and Improvement	Length of stay	1260.500	3888.500	-0.244	0.808
	Total Income	1058.500	3836.500	-1.658	0.097
No change and deterioration	Length of stay	786.000	2164.000	-1.357	0.175
	Total Income	865.000	2243.000	-0.640	0.522

Source: Survey data (2022)

The Post-hoc Mann-Whitney U test showed that there is a statistically significant difference between all three cross-products of the three groups of household perceptions since the p-value for all cross-products is greater than 0.05.

4.4.4. Diagnostics to assess the degree of multicollinearity

The Variance Inflation Factor (VIF) measures the severity of multicollinearity in regression analysis. Multicollinearity is when there is a correlation between predictors (explanatory variables) in a model. The VIF estimates how much the variance of a regression coefficient is

inflated due to multicollinearity. The variance inflation factors range from 1 upwards. A rule of thumb for interpreting the variance inflation factor: 1 being not correlated, between 1 and 5 moderately correlated, and greater than 5 being highly correlated. The VIF test results displayed in Table 4.6 proved that there is no multicollinearity problem between the predictor variables. All variables have a VIF of less than 10.

Table 4. 6: Diagnostic to assess the degree of multicollinearity.

Variables	VIF	1/VIF
Access to electricity	8.50	0.118
Dwelling type	8.30	0.120
Age	2.76	0.362
Level of education	1.94	0.515
Gender	1.68	0.595
Access to clean water	1.39	0.717
Employment status	1.21	0.827
Marital status	1.12	0.893
Mean VIF	3.36	

Source: Survey data (2022)

4.4.5. Diagnostic to assess heteroscedasticity

The value of the heteroscedasticity test is 0.2681 which is greater than 0.05 meaning the null hypothesis of homoscedasticity cannot be rejected. Therefore, there is no evidence of heteroscedasticity.

4.4.6. The goodness of fit statistics for the OLR model

The goodness of fit can be assessed through the Pearson and Deviance chi-square tests, with p values greater than 0.05 signifying better fit. Statistical significance is not required in this situation since it would show that the final model differs from a perfect model. Non-significant means that the final model reproduces the observed frequencies at all relevant levels of the outcome in an adequate manner. The significance level for both person and deviance is greater than 0.05. Therefore, the null hypothesis is rejected. This implies a better fit of the model.

4.4.7. Model fitting information

Intercept Only refers to a model that merely fits an intercept to predict the result variable without adjusting for any predictor factors. A model is referred to as final if it contains the requisite predictor variables and its coefficient was calculated through an iterative process that maximized the log-likelihood of the result. The chi-square statistic is used to test whether the improvement is statistically significant, with p values less than.05 suggesting model fit. Model fit is evaluated by comparing the 2-log likelihood for the intercept-only model to the full model.

The −2 log-likelihood is computed for the intercept-only model, or the model without any independent variables, and the final model with all independent variables. The −2 log-likelihoods for each are subtracted from one another to produce the chi-square (238.325 – 188.286 = 50.039). A greater amount of change between the two models suggests a greater improvement in model fit. Significance at less than 0.05 suggests model fit. The final model is significantly different from the intercept-only model ($p < 0.001$). Thus, the independent variables, as a group, contribute significantly to the prediction of the outcome.

4.4.8. Test of parallel lines for the Ordered Logistic regression model

The test of proportional odds is commonly referred to as the test of parallel lines because the null hypothesis states that the slope coefficients in the model are the same across response categories (and lines of the same slope are parallel). Since the ordered logit model estimates one equation overall levels of the response variable (as compared to the multinomial logit model, which models, assuming low ses is our referent level, an equation for medium ses versus low ses and an equation for high ses versus low ses), the test for proportional odds tests whether our one-equation model is valid. If the null hypothesis was rejected based on the significance of the Chi-Square statistic, the conclusion would be that ordered logit coefficients are not equal across the levels of the outcome, and we would fit a less restrictive model (i.e., multinomial logit model). If the null hypothesis is not rejected, the conclusion is that the assumption holds

For the model, the Chi-Square statistic is 0.094 which is greater than 0.05. Therefore, the null hypothesis is not rejected that the location parameters are the same across response categories. This implies the assumption of proportional odds holds.

4.4.9. The Pseudo R-square for the ORL model

The three different pseudo-R-Squared summary statistics were used to assess the model fit by determining the effect size of the model. There is disagreement on the use of the pseudo-R^2; (Petrucci, 2009) suggests that it approximates the same variance interpretation as R^2 in linear regression (meaning accounting for the amount of explained variance in the outcome variable), and Hosmer and Lemeshow (2000) recommend using it for model building only. It is instructive nonetheless to become familiar with the three commonly included pseudo-R^2 statistics. All of the pseudo-R^2 statistics are typically much lower than the R^2 statistics in linear regression. McFadden's is a transformation of the likelihood ratio statistic. It is computed by dividing the following:

$$\frac{1 - (\,ratio\ of\ loglikelihood\ of\ the\ null\ model)}{(the\ \log likehood\ of\ the\ constant\ model\ only)}$$

Values from 0.2 to 0.4 for McFadden are considered "highly satisfactory" (Petrucci, 2009). The Cox and Snell pseudo-R^2 is also based on the log-likelihoods and considers sample size, but it cannot achieve a maximum value of 1. Nagelkerke pseudo-R^2 adjusts Cox and Snell so that a value of 1 is possible.

For this analysis, pseudo-R^2 statistics were as follows: Cox and Snell, 269.; Nagelkerke, 0.305; and McFadden, 0.147 as presented in table 4.11 above. Based on McFadden's Pseudo R-square we can infer that the full model containing predictor variables represents a 14.7% improvement in fit relative to the null model. Therefore, the Pseudo R-square for the model is considered to be a bit low.

4.5. The determinants of household's perceptions towards trees in their environment

The threshold estimate for (HouseholdPerceptionOfTrees=1) is the cut-off value between the low and middle household perception of trees and the threshold estimate for (HouseholdPerceptionOfTrees=0) represents the cut-off value between middle and high household perception of trees. For (HouseholdPerceptionOfTrees=1) this is the estimated cut point on the latent variable used to differentiate a low household perception of trees from a middle and high household perception of trees when values of the predictor variables are evaluated at zero. Determinants that had a value of 12.714 or less on the latent variable gave rise to the

household perception of trees variable were classified as a low household perception of trees. For (HouseholdPerceptionOfTrees=0) this is the estimated cut point on the latent variable used to differentiate low household perception of trees from the middle and high household perception of trees when values of the predictor variables are evaluated at zero. Determinants that had a value of 14.497 or greater on the underlying latent variable that gave rise to the household perception of trees variable would be classified as the high household perception of trees. The result shows that the statistically significant determinants of households' perceptions of trees in their environment were gender, age, marital status, and dwelling type. Employment status, level of education, access to electricity, and access to clean water were all found to be statistically insignificant.

Table 4. 7: The determinants of household perceptions towards trees

	Estimate	**Std. Error**	**Wald**	**df**	**Sig.**
HouseholdPerceptionOfTrees = 1	12.714	0.856	220.854	1	0.001
HouseholdPerceptionOfTrees = 0	14.497	0.832	303.450	1	0.001
Gender=0	1.002	0.432	5.373	1	0.020
Age=1	15.506	0.676	526.508	1	0.001
Age=0	16.479	0.600	753.539	1	0.001
MaritalStatus=0	-0.803	0.354	5.146	1	0.023
EmploymentStatus=0	0.275	0.354	0.604	1	0.437
YearsOfEducation=0	-0.216	0.492	0.193	1	0.661
DwellingType=1	-3.098	1.142	7.352	1	0.007
AccessToElectricity=1	0.877	1.028	0.729	1	0.393
AccessToCleanWater=1	0.106	0.488	0.047	1	0.829

Source: Survey data (2022)

Gender: The household head gender was statistically significant at 5% and 10% levels of significance and positively related to the household's perceptions of trees in their environment. This implies that the ordered logit for females being in a higher household perception of trees category is 1.002 more than that for males when the other variables in the model are held constant. This result suggests that females have strong environmental perceptions of trees in their

environment compared to males. This result is in line with findings by Zelezny et al. (2000), who found females are more predisposed to environmental protection than males.

Age: The household head age (young adults and old adults) was statistically significant at all levels of significance and positively related to the household's perceptions of trees in their environment. This implies that ordered logit for age, young adults, and old adults being in a higher household's perceptions of trees category are 15.506 and 16.479 respectively more than elders when all the other variables in the model are held constant. This result suggests that young adults and old adults have strong environmental perceptions of trees in their environment compared to elders. This result is in line with the findings by Dlamini et al. (2021), who found a negative correlation between age and environmental sentiments and pro-environmental behaviour as people get older.

Marital status: The household head's marital status was statistically significant at 5% and 10% levels of significance and positively related to the household's perceptions of trees in their environment. This implies that the ordered logit for unmarried household heads being in a higher household perception of trees category is -0.803 less than married household heads when all the other variables in the model are held constant. This result suggests that unmarried household heads have positive environmental perceptions of trees in their environment compared to married household heads.

Dwelling type: The household dwelling type variable was statistically significant at all levels of significance and negatively related to the household's perceptions of trees in their environment. This implies that the ordered logit for the formal dwelling type being in a higher household's perceptions of trees category is -3.098 less than the informal dwelling type when all other variables in the model are held constant. This result suggests that household heads living in formal dwellings have strong environment perceptions of trees in their environment compared to households living in informal dwelling. This result is in line with the finding by Dlamini et al. (2020), who found dwelling type (formal) to be a strong determinant of both environmental perceptions and attitudes.

4.6: Discussion

In determining environmental perceptions, socioeconomic factors and household demographics are significant. This study attempts to explore determinants of households' perceptions of trees in their environment in eThekwini district, KwaZulu Natal province. Statistical results indicated

that predictor variables such as gender, age, marital status, and dwelling type were strong determinants of household perceptions of trees in their environment. These findings should be interpreted cautiously since they could have been impacted by other latent variables unrelated to respondents' opinions about how they relate to the social and natural environment as a whole. The direct questions and the way they are worded might potentially miss other sentimental and emotional responses and actions that could also affect how concerned people are about the environment (Brehm et al., 2006). They do, however, provide insight into some of the socio-demographic variables that affect how people and nature interact in a socio-demographically varied region like South Africa's eThekwini district. The findings are examined concerning pertinent literature.

Gender (Female) was a significant predictor of the household's perceptions of trees in their environment. Gender has also been widely studied as a factor affecting environmental attitudes, with females being more inclined towards environmental protection than males (Zelezny et al., 2000), not environmental perceptions. One of few South African studies that included gender as a predictor of environmental perceptions (Dlamini et al., 2020), found gender was not a statistically significant predictor of environmental perception but of environmental attitudes. Regardless, other research has revealed that women exhibit higher levels of environmental sentiments than men. Dietz et al. (2002), in their study, found females to be more positive in their environmental attitude than males. Women are more empathetic, protective, and caring due to cultural norms, gender socialization, and the responsibilities of motherhood and caregiving. As a result, there may be increased environmental understanding and a tendency to conserve the natural world (Levy et., 2018; Casey and Scott, 2006).

Age was a strong determinant of households' perceptions of trees in their environment. In our study, we found that young adults people aged 18 to 35 years and old adults' people aged 36 to 54 years have more positive perceptions of trees in their environment compared to elders, people above 54 years of age. There is scant research that has investigated age as a predictor of environmental perceptions, most research has focused on age as a predictor of environmental attitudes and concerns. However environmental concern is a distinct aspect of broader environmental perceptions. Environmental concern refers to the effect or feeling connected with environmental issues such as resource availability, accessibility, and environmental quality (Schultz et al., 2005). Dlamini et al. (2020), found that age does not influence environmental

perceptions and attitudes. However, this is an angle that requires further research as international literature on age as a predictor variable of environmental perception is scant.

Marital status was a moderate determinant of households' perceptions of trees in their environment. There is scant literature on marital status and environmental perceptions. Therefore, there is a poor understanding of the precise relationship between marital status and environmental perceptions. The analysis revealed that unmarried household heads have more positive perceptions of trees in their environment compared to married household heads. Further research is required because there is a dearth of international literature on marital status as a predictor of environmental perceptions.

Dwelling type has received little attention in the discussion of socioeconomic factors and household demographic characteristics influencing environmental perceptions. In our study dwelling type was a strong determinant of households' perception of trees in their environment. This is consistent with findings by Dlamini et al. (2020), who found dwelling type as a strong determinant of both environmental perceptions and attitudes. The study area (Buffelsdraai and Osindisweni) is made up of formal and informal settlements, especially in the Buffelsdraai area, and semi-rural dwellings in the Osindisweni area. Dwelling type is associated with a socioeconomic level in South Africa, as well as in other regions of the world (Jones et al., 2015). Dwelling type, therefore, can be linked to the socioeconomic status of the household, affordability of formal house, and place of residence. Environmental perceptions pertain to how an individual observes or evaluates environmental concerns (Hunter et al., 2010), whereas environmental concern refers to the effect or feeling connected with environmental issues such as resource availability, accessibility, and environmental quality (Schultz et al., 2005). As a result, environmental concern is a distinct aspect of broader environmental perceptions. Environmental concern has been demonstrated to be a significant indirect predictor of certain environmental behaviour and has been linked to environmental attitudes (Bamberg, 2003). Further investigation is required because there is a dearth of international literature on dwelling type as a predictor of environmental perceptions.

4.7. Conclusion

The findings provide evidence that some variables are more significant than others in predicting households' perceptions of trees in their environment. Gender, age, marital status, and dwelling type were all significant predictors of households' perceptions of trees in their environment.

Notably, employment status, level of education, access to electricity, and access to clean water had no significant influence on households' perceptions of trees in their environment. This was obtained using the ordinal logistic regression model. Understanding the drivers of households' perceptions towards trees in their environment, which have ramifications for human–nature relationships, is one method academics can encourage sustainable and pro-environmental behaviour. This study has the potential to lay a foundation for the comprehension of some sociodemographic factors that may influence environmental behaviours, such as involvement in environmental initiatives like recycling, reforestation, afforestation, and climate change mitigation and degradation, which is important for developing environmental planning and strategy. Understanding the drivers of environmental perceptions and attitudes, which have ramifications for human–nature relationships, is one method academics can encourage sustainable and pro-environmental behaviour.

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CHAPTER 5: THE PERCEIVED IMPACT OF ECOLOGICAL RESTORATION ON HOUSEHOLD LIVELIHOODS IN PERI-URBAN AND RURAL AREAS OF ETHEKWINI DISTRICT, SOUTH AFRICA

Abstract

The study of the contribution of income from the forest to rural livelihoods has gained traction in recent years. In emerging regions, environmental resources are crucial to rural livelihoods. In particular, ecological resources like fuelwood, wild foods, medicinal plants, and building materials are essential to the survival of peri-urban and rural communities. In addition to using forest resources to meet their basic requirements, people in developing countries also trade these resources to make a sizeable profit. There is scant background information about the situation in eThekwini district, KwaZulu Natal province in regards impact of ecological restoration on household livelihoods. This study evaluates the perceived impact of ecological restoration on household livelihoods in peri-urban and rural areas of the eThekwini district. Primary data on fuelwood, medicinal plants, wild fruits, material to build houses, and household socio-demographic characteristics were collected from 160 household heads. Descriptive statistics such as frequencies, percentages, and chi-square were used to describe household and community characteristics. Principal component analysis (PCA) was used to generate composite indices representing perceived income from the ecological restoration projects. Ordinary Least squares were then employed to determine the factors influencing such valuation of the ecological restoration project. They showed that socioeconomic and demographic factors such as age ($p<0.00$), gender (0.060), total monthly income ($p<0.039$), years of education ($p<0.001$), household size ($p<0.073$), and access to forest resources ($p<0.032$) influence perceived income from the restoration project. The study concludes that households that depend on forest income as a matter of necessity could potentially be impacted by restrictions to access to forest resources, and it suggests that households' socio-economic factors should be considered in ecological restoration interventions to apply target-oriented actions and policing activities.

Keywords: Ecological restoration; household livelihoods; forest ecosystem goods and services

5.1. Introduction

Ecological restoration has a large scope and present investment, as do the demands placed on it to improve livelihoods and well-being. Ecological restoration has been recommended as a means

of combating deforestation and balancing ecosystem services and goods production with conservation and development aims. Forests act as a safety net, assisting rural people in avoiding, mitigating, and escaping poverty (Hobley, 2005). Forests provide wood, and non-timber forest products and ecosystem services and goods to society as a whole that may be consumed for better food security and nutrition as well as used to create revenue (Le et al., 2012) and are particularly vital to rural communities. According to the World Bank, forest resources directly contribute to the well-being of about one billion people in developing nations who live in extreme poverty (Bhargava, 2006). Rural households' livelihoods and forest restoration are inextricably linked. Forest-derived goods and services are vital for most rural poor people, whose sustenance is typically dependent on access to and control over forest resources. Hundreds of millions of people in rural regions rely on a combination of forest and agricultural resources to meet their basic requirements (Adams et al., 2016).

In this Chapter, the empirical models and findings regarding the impact of ecological restoration on household livelihoods are presented and discussed, which addresses the study's third objective.

5.2. Research Methods

5.2.1. Data

As described in chapter 3, data for this chapter included 160 randomly selected household heads from two districts of KwaZulu Natal Province. The relevant questionnaire module for this chapter included information on household heads' demographics and socioeconomic characteristics such as age, gender, total monthly income, years of education, and access to forest resources. Also relevant measures of ecosystem products (e.g. fuelwood, medicinal plants, wild fruit and vegetables, and material to build houses). The module specific to this chapter was asking questions about the perceived impact of the ecological restoration project on household livelihoods. This includes whether households have obtained income from selling ecosystem products and whether the household has obtained income from the restoration project.

5.2.2. Analytical Model

Principal component analysis (PCA) was used to generate composite indices representing perceived income from the ecological restoration projects. Ordinary Least squares were then

employed to determine the factors influencing such valuation of the ecological restoration project.

5.3. The Empirical Models

5.3.1. The Principal Component Analysis

This study employed a principal component analysis to evaluate the perceived impact of ecological restoration on household livelihoods in peri-urban and rural areas of the eThekwini district. PCA is a statistical approach for transforming a large number of correlated data into a smaller collection of uncorrelated composite variables known as principal components. The principal component analysis was based on the covariance matrix in this study. The principal components with an eigenvalue of more than 1 were regarded as explained principal components. Perceived impacts of ecological restoration on household livelihoods were evaluated by assessing the benefits of forest ecosystem services contributing to household livelihoods due to the establishment of ecological restoration projects. Household livelihoods perception was assessed on fuelwood, wild fruits, and vegetables, medicinal plants, and material to build houses using a five Likert scale ranging from 1- Strongly Agree, 2- Agree, 3- Neutral, 4- Disagree, 5- Strongly Disagree. Composite indices were created regarding ecosystem services to assess their impact on household livelihoods. Ecosystem services refer to the advantages that individuals obtain from functioning ecological systems (La Notte et al., 2017). The study focused on forest ecosystem services that ecological restoration provides for direct benefits as ecosystem goods and services.

To assess perceived household livelihoods participants were asked if they have obtained any income from the restoration project: Yes, or No. Household livelihoods perception was assessed on fuelwood, wild fruits, and vegetables, medicinal plants, and material to build houses, using a two-Likert scale. Fuelwood is the major source of forest income (Kamanga et al., 2009). Participants were asked if they have obtained any income from selling fuel wood; Yes, or No. Fuelwood is an essential ecosystem provisioning service that has been found to support rural livelihoods as an important source of energy for cooking (Lee et al., 2015). The use of fuelwood for cash income has been found to support household livelihood (Ahammad et al., 2019). As a result, a positive influence of the variable fuelwood in household livelihoods is expected. Participants were asked if they have obtained any income from selling wild fruits and vegetables; Yes, or No. Ahammad et al. (2019), underlined the importance of forest-sourced foods in rural communities' livelihoods. Forests supply wild fruits and vegetables that help people eat a variety

of foods to support livelihoods and food security (Sunderland et al., 2013; Chettri et al., 2021). Therefore, a positive influence of the variable wild fruits and vegetables in household livelihoods is expected. Participants were asked if they have obtained any income from the selling of medicinal plants; Yes, or No. Medicinal plants provided by forests have been found to support rural livelihoods (Mofokeng, 2008). According to a study by Makhado et al. (2009), most people in South Africa rely on medicinal plants for health treatment and revenue-generating to some level. Thus, a positive influence of the variable medicinal plants is expected in households' livelihoods. Participants were asked if they have obtained income from selling materials to build houses; Yes, or No. In most rural parts of southern Africa, the use of wood material for construction is a prevalent practice (Van Wyk and Gericke, 2000). Construction raw materials from the forest have been found to support livelihoods (Ahammad et al., 2019). As a result, a positive influence of the variable material to build houses is expected in households' livelihoods.

5.3.2. The Ordinary Least Squares (OLS)

The study employed an ordinary least square to evaluate the predictive power of socioeconomic and demographic factors as drivers of the dependent perceived household livelihoods from an ecological restoration project in peri-urban and rural areas of eThekwini district. The ordinary least squares (OLS) method is a linear regression technique that is used to estimate the unknown parameters in a model. The method relies on minimizing the sum of squared residuals between the actual and predicted values. In the case of a model with p explanatory variables, the OLS regression model writes:

$$Y = \beta 0 + \beta 1xi \ldots\ldots + \beta pXp + \varepsilon i$$

Where:

Y=is the dependent variable

βo = is the intercept of the model

βs = are parameters to be estimated

Xs = are vectors of explanatory variables

εi = is the stochastic error term

Household head age, household head gender, household head educational level, and household head estimated income was chosen as drivers of the dependent perceived household livelihoods.

Participants were asked what their estimated monthly income is. Participants were asked what their age is. The age of an individual has been associated with environmental perceptions and attitudes (Dlamini et al., 2020). A positive influence is expected of the variable household head age on perceived household livelihoods from the ecological restoration. Gender has been associated with environmental perceptions and attitudes (Dlamini et al., 2020). Females are more predisposed to environmental protection than males (Zelezny et al., 2000). Income level has been found to influence an individual's environmental perceptions and attitudes (Uddin et al., 2017). Therefore, a positive influence of the variable household head estimated income on perceived household livelihoods from ecological restoration is expected. Participants were asked; how many years of education did they obtain. Educational level has been found to influence to individual's environmental perceptions (Dlamini et al., 2020). Thus, a positive influence is expected of the variable household head educational level on perceived household livelihoods from the ecological restoration.

5.4. Results

The results of descriptive statistics of household demographics, PCA, and Ordinary Least Squares regression are presented in this section. For household demographics and characteristics, descriptive statistics such as frequencies and percentages were used. For the perceived impacts of ecological restoration on household livelihoods Principal component analysis (PCA) was used to generate composite indices representing perceived income from the ecological restoration projects. Ordinary Least squares were then employed to determine the factors influencing such valuation of the ecological restoration project.

5.4.1. Sociodemographic profile of the sample for each community in the study

A total of 160 persons who lived in five communities located in the two areas of Buffelsdraai and Osindisweni were interviewed and participated in the survey. 126 adults live in the four-community Buffelsdraai region, and 34 adults live in the Osindisweni area. All age and gender groups are equally represented in the sample of people who were questioned, except for a slight overrepresentation of women and young adults. Descriptive statistics were calculated to help understand the data and display the demographics of the sample. Percentages (%) were used to derive the sociodemographic characteristics of the population. Using descriptive statistics scale frequencies and response percentages were calculated.

Young adults (42.5%), female household heads (57.5%), and unemployed (52.5%) individuals made up the majority of the sample. The majority of household heads (74.4%) had access to electricity, and 80% had access to potable water. The average length of stay in an area of respondents was 16.4 years of stay (SD = 14.092), with the minimum years of stay being 1 year and maximum years of stay being 78 years. The sociodemographic profile of the sample for each community in the study is presented in table 5.1.

Table 5.1: Sociodemographic profile of the sample for each community in the study.

Characteristics of communities	**Osindisweni (%)**	**Buffelsdraai (%)**	**Overall sample (%)**
Employed household heads	72.2	40.3	47.5
Unemployed household heads	27.8	59.7	52.5
Social grants as the main source of household income	69.4	59.7	61.9
Male-headed households	11.1	51.6	42.5
Female-headed households	88.9	48.4	57.5
Households with access to electricity	83.3	71.8	74.4
Married household heads	55.6	41.1	44.4
Unmarried household heads	44.4	58.9	55.6
Households selling forest products	11.1	11.3	11.3
Households with access to clean water	52.8	87.9	80.0

Source: Survey data (2022)

5.4.2. Perceived impact of ecological restoration on households' livelihoods.

The PCA method was used in this study to create composite indices or variables that represented the obtained income from selling ecosystem services from the ecological restoration initiatives. This was accomplished by using PCA on the relative relevance scores of 6 forest ecosystem goods and services that were identified based on prior studies (Sunderland et al., 2013; Lee et al., 2015; Ahammad et al., 2019). This study revealed the unrotated component matrix. Since all scales were measured in the same units, the covariance matrix was used to extract seven principal components. The first two factors accounted for 45.53% and 27.46%, respectively, of the

variation. The results of the 6 major components are displayed in Table 5.2. 72.99% of the variation in the analysed variable was explained by the first two main components. The many elements showed how households in Osindisweni and the four communities in Buffelsdraai (Two room, Emasabisidi, Emagcakini, and Mangona) in eThekwini district, KwaZulu Natal Province, obtained income from selling the forest ecosystem's goods and services. The first two PCs from the set of six were retained because they had Eigen values greater than one and permitted a useful interpretation of the PCs. Utilizing the relative component loadings, the three PCs were identified and given names. Absolute PC loadings greater than 0.05 were regarded as dominant. The results of factor analysis to extract principal components are presented in Table 5.2.

Table 5.2: Results of factor analysis to extract principal components**.**

Components	**Initial Eigen Values**		
	Total	**% of variance**	**Cumulative %**
1	2.732	45.530	45.530
2	1.648	27.461	72.990
3	0.569	9.480	82.470
4	0.451	7.523	89.993
5	0.331	5.524	95.518
6	0.269	4.482	100.000

Source: Survey data (2022)

Based on the dominant component loading in Table 5.2, the first PC shows that households that obtained high income on fuelwood also obtained high income on medicinal plants, wild fruits, and materials to build houses. These income benefits are all associated with the selling of forest ecosystem products that improve household livelihoods. Such ecosystem services are referred to as provisioning ecosystem services. Thus, the first PC represented provisioning forest ecosystem products income obtained by households from ecological restoration projects. It explained 45.53% of the variation in the variables included in the model. The second PC shows that households that obtained income from the restoration projects also have members of their households working on the restoration projects. Thus, the second principal component represented restoration employment income from the ecological restoration project.

5.4.3. Results of KMO and Bartlett's test

The KMO and Bartlett test evaluate all available data together. KMO returns values between 0 and 1. KMO values between 0.8 and 1 indicate the sampling is adequate. KMO values of less than 0.6 indicate the sampling is not adequate and that remedial action should be taken. Bartlett's test is used to test if the k sample has equal variances. Equal variances across samples are referred to as homogeneity of variances. If the p-value that corresponds to the test statistics is less than the significance level of 0.5 then we can reject the null hypothesis and conclude that not all groups have the same variance.

Since our KMO value of 0.715 is greater than 0.50, this result is considered appropriate for carrying out the factor analysis. Bartlett's p-value of 0.0001 is less than 0.5, this result is significant to carry out the factor analysis.

5.5. Factors influencing the perceived impact of ecological restoration on household livelihood

The factors impacting the perception of the impact of ecological restoration on household livelihoods were initially examined using ordinary least squares. The first two composite indices or components representing the perceived effect of ecological restoration on household livelihood were regressed against households' socioeconomic indicators and demographic features. The F-statistics for both OLS models were significant at the 1% threshold of significance. The goodness of fit R^2 value for both regressions, however, was under 0.5. These findings are typical of studies on the utilization of human resources. Similar findings were reached by Sharaunga (2012) when examining the variables determining the values that households attach to forest resources. Similar findings were reached in research on predicting the causes of forest degradation by Coomes et al. (2000). Given the abundance of potentially confounding socioeconomic variables and the intricacy of interactions among them, the low goodness of fit, R^2 value illustrates the difficulties in forecasting human behaviour (Coomes et al., 2000).

Testing of heteroscedasticity and multicollinearity was also made possible by the use of OLS. Since all variance inflation factors (VIF) for the explanatory variables employed in both OLS regressions were less than the critical value of 10, and all tolerance factors were close to one, there was no multicollinearity among them. There was no evidence of heteroscedasticity in both OLS regressions. The results of the estimated OLS regressions are presented in Table 5.3 below.

Table 5.3: Diagnostic to assess the degree of multicollinearity

Variables	**Collinearity statistics**			
	Forest ecosystem products income		**Restoration employment income**	
	VIF	Tolerance	VIF	Tolerance
Age	2.13	0.469	2.22	0.469
Year of education	1.55	0.646	1.62	0.646
Gender	1.53	0.652	1.54	0.652
Total monthly Income	1.14	0.880	1.13	0.880
Access to forest resources	1.06	0.947	----	----------
Household size	1.04	0.958	1.02	0.958
Mean VIF	1.41		1.51	

Source: data survey (2022)

Note

--- mean that the variable was not used in the regression model.

5.5.1. Results of the Breusch-Pagan / Cook-Weisberg test for heteroscedasticity.

The values of the heteroscedasticity test are 0.255 and 0.489, respectively, which is greater than 0.05 meaning we do not reject the null hypothesis of homoscedasticity. Therefore, there is no evidence of heteroscedasticity.

5.5.2. Factors influencing the perceived forest ecosystem products income

Table 5.4 shows that gender, age, total monthly income, household size, years of education, and access to forest resources were statistically significant predictors of forest ecosystem products income.

Table 5.4: Factors influencing the perceived forest ecosystem products income

ForestEcosystemIncome	**Coefficients estimate**	**Standard Error**	**P>| t |**
Gender	0.146	0.077	0.060
Age	0.492	0.057	0.000

TotalMonthlyIncome	-0.085	0.041	0.039
HouseholdSize	-0.104	0.057	0.073
YearsOfEducation	0.212	0.061	0.001
AccessForestResources	0.140	0.064	0.032
Constant	0.318	0.242	0.191
R^2-value	0.438		
F-sig	0.000		

Source: Survey data (2022)

The most readily available sources of goods and revenue for many nearby rural populations in developing nations are natural forest resources (Mutenje et al., 2011). In the semi-arid tropics of Africa, NTFPs considerably contribute to the livelihood of rural households (Heubach et al., 2011). The forest ecosystem product income was positively associated with the household head being male (Gender=1) and statistically significant at a 10% level. Male household heads perceived that income increased from selling forest ecosystem products (i.e., fuelwood, medicinal plants, wild fruits, and material to build households) from the ecological restoration project than female-headed households, *ceteris paribus*. This can be ascribed to the strenuous nature of forest ecosystem extraction activities, which are labour-intensive and necessitate greater physical stamina and longer forays into the forest to harvest forest products, tasks that males are better at. These results are consistent with findings by Thondhlana et al. (2012), and Adam and EI Tayeb (2014), who found that males were more likely than females to depend more on environmental and forest resources. Men were cited in these studies as being involved in the selective harvesting of forest resources, particularly those of commercial value, such as firewood. So, in comparison to their counterparts, they extracted more resources for sale. However, these results are contrary to the finding by Teshome et al. (2015), who found forest income contributes more to the total household income of female-headed households than to the total household income of male-headed households. This was attributed to the fact that forest product collections in many cases is one of the few options available to rural women to generate independent cash income. According to Uberhuaga et al. (2012), women are known to be highly dependent on common pool resources including forest resources.

The coefficient estimate for age was positive and statistically significant at all levels of significance This implies that a one-year increase in the age of the household head causes, on average, 0.492 increase in forest ecosystem product income from the restoration project, *ceteris*

paribus. Old household heads perceived increased forest ecosystem products income from selling forest ecosystem goods and services from the restoration project than young household heads. These results are realist elders who are retired from work, with less involvement in various economic likely to perceive forest ecosystem product income due to their high dependency on forest ecosystem products for livelihood than young individuals. Furthermore, elderly people are more likely to have more knowledge of medicinal plants in the forest than young people. In addition, the high unemployment rate amongst elders necessitates old people to be more reliant on the natural resources endowed in their environments such as forest ecosystem goods and services. In comparison to youths, who can readily find employment outside the forest, young villagers in rural communities generally exhibit less dependence on forest goods, according to Jain and Sajjad (2016). However, these results are contrary to findings by Garekae et al. (2017), who found that older members of the household have a lower likelihood of collecting forest products due to their decreased mobility.

The TotalMonthlyIncome variable reflected the off-farm income generated from employment (wages and salaries) and other sources of income such as old age pension grants and child support grants. The negative and statistically significant coefficient estimate corresponding to household total monthly income (TotalMonthlyIncome) suggests that households generating more off-farm income perceived less forest ecosystem product income from the ecological restoration income project. The household total monthly income showed high statistical significance at a 5% level of significance, implying that the proportion of forest ecosystem products income by high-income households decreases as household total monthly income increases. This implies that a one-rand increase in household total monthly income, on average, decreases forest ecosystem product income by ZAR 0.085, *ceteris paribus*. This suggests that other revenue sources including agriculture, salaried jobs, and self-employment would become more economically significant in comparison to income from environmental resources. Better-equipped households won't allocate human capital to low-yielding forest activities (Nkoana, 2014). Forestry operations are frequently the only source of cash income for disadvantaged communities (Vedeld et al., 2004). However, these results are inconsistent with the conclusion that absolute forest income rises with total household income in line with previously reported findings, such as those from Nyssen et al. (2003), and Escobal and Aldana (2003). In Malawi, Kamanga et al. (2009), discovered a comparable effect where wealthy households receive more revenue from the forest than poor households. According to Vedeld et al. (2004), better-off households diversify their

livelihood strategies by including forest revenues in their household economy when specific circumstances apply, such as when there are no other viable options.

The coefficient estimate for household size was negative and statistically significant at a 10% level of significance. This implies that a one-unit increase in household size, on average, will decrease forest ecosystem products income by –ZAR0.104, *ceteris paribus*.This indicates that as families get large, households get less reliant on forest ecosystem products income to enhance their livelihoods. This is contrary to what was expected, and the most plausible explanation is that lucrative non-forest income streams are accessible and may be used. However, these results are in line with findings by Gerakae et al. (2017), in Botswana who also reported a negative relationship between household size and forest dependency. According to prior findings by Jan and Sajjad (2016), and Soe et al. (2019), families with big numbers of members must eat more food and are more likely to gather more forest products to survive. Hence large households are expected to sell more forest ecosystem products, therefore, perceived more ecosystem forest products income than small households in reality. Additionally, large families are more dependent on forest goods to meet their basic needs as a result of the rising unemployment rate in areas far from the forest (Hussain et al., 2019). According to research from Babulo et al. (2009), in Ethiopia, Kamanga et al. (2009), in Malawi, and Tumusiime et al. (2011), in Uganda, larger size households are more likely to obtain forest income than smaller size households. This relationship's pattern is caused by the fact that larger homes need more fuel wood and food from the forest, which is typically taken from the forest, especially when it's difficult to buy food for the household from the market. In developing areas like Buffelsdraai and Osindisweni area, large household size frequently requires diverse forest resources to meet their daily needs, so there is a stronger tendency to depend on revenue from forest ecosystem products. Different demographic profiles between the current study and the aforementioned studies, such as different household sizes, maybe the other rationale for this unexpected conclusion. The average household size in the current study was lower than that of the earlier studies, which were made up of somewhat bigger households with an average of six persons.

The coefficient estimate for the years of education of the household head was positive and statistically significant at all levels of significance. This implies that with a one-year increase in the level of education of the household head, on average, the forest ecosystem products income increases by ZAR0.212, *ceteris paribus*. This is contrary to expectations and this can be attributed to the fact that there are high levels of unemployment in the area, and there are less lucrative

employment opportunities for educated people in the region, which enhances their dependency on environmental and forest resources to meet their basic needs. Studies carried out elsewhere discovered that households' reliance on forests was greatly and adversely impacted by income from employment and other regular paid activities (Mamo et al., 2007; Tieguhong and Nkamgnia, 2012). In these researches, the extraction of forest products was not a favoured or regular activity but rather one that people engaged in as a stand-in when they were not working. Additionally, the researched communities' diversified livelihood portfolios as opposed to the current study contributed to the strong connection. Higher-educated households frequently have access to more stable non-farm earning options and frequently have a larger asset base (Angelsen et al., 2014). People who have received a formal education, according to Mosozera and Alavalpati (2004), have a variety of livelihood possibilities that could yield higher returns than work involving the forest. These findings are consistent with findings by Baiyegunhi et al. (2016), who contended that better employment alternatives provided by higher education shift the focus of available livelihood options away from collection activities like the extraction of natural resources.

The coefficient estimates for access to forest resources (AccessForestResources) were positive and statistically significant at 5% and 10% levels of significance. This implies that a one-unit increase in household access to forest resources, on average, *ceteris paribus*, will increase forest ecosystem product income from the ecological restoration projects. These results are consistent with the expectation that with more access to forest resources people will be able to obtain more income from selling forest products which will enhance their livelihoods. These results are in line with prior research findings by Angelsen et al. (2014), who found that households with better access to forests report higher overall income.

5.5.3. Factors influencing the perceived restoration employment income

Table 5.5 shows that age, gender, and years of education were statistically significant predictors of income from employment in the restoration project. Total monthly income and household size were not statistically significant predictors of restoration employment income.

Table 5.5: Factors influencing the perceived restoration employment income

RestorationEmploymentIncome	**Coefficient estimate**	**Standard error**	**P>| t |**	**N=160**
Gender	0.505	0.084	0.000	
Age	0.485	0.063	0.000	

TotalMonthlyIncome	0.024	0.044	0.583
HouseholdSize	0.053	0.063	0.403
YearsOfEducation	0.229	0.066	0.001
Constant	-0.137	0.259	0.596
R^2 value	0.307		
F-sig	0.000		

Source: data Survey (2022)

The coefficient estimate of the household head gender was positive and statistically significant at all levels of significance. This indicates that males (Gender=1) increased restoration employment income from the ecological restoration income more than females, *ceteris paribus*. This is an angle that requires further research as international literature on gender as a predictor of perceived contributions of ecological restoration on household livelihood is scant. Notably, total monthly income and household size were not statistically significant predictors of restoration employment income from the restoration income but both had a positive influence on the dependent variable.

The coefficient estimate of the age of the household head was positive and statistically significant at all levels of significance. This implies that a one-year increase in the age of the household head increases restoration employment income from the ecological restoration project on average by ZAR0. 485, *ceteris paribus*. This indicates old household heads are more likely to be employed in ecological restoration projects than young household heads. These results are young people are more involved in economic activities and are more likely to migrate for better employment opportunities therefore, are less likely to perceive restoration employment income than old people. This is an angle that requires further research as international literature on age as a predictor variable of perceived contributions to ecological restoration on household livelihoods is scant.

The coefficient estimate of the household head years of education was positive and statistically significant at all levels of significant. This implies that a one-year increase in household head years of education increases restoration employment income from the ecological restoration project on average by ZAR0.229, *ceteris paribus*. This could be attributed to the fact that household heads with higher levels of education are more likely to get better employment opportunities in restoration initiatives. These findings are at odds with those of Godoy and Contreras (2001), who found that education increases the likelihood of off-farm employment,

self-employment, and access to better job facilities outside of forested areas, which lessens reliance on such resources. This is because of the opportunity of labour for better-educated household heads due to better access to a greater diversity of employment and income opportunities (Vedeld et al., 2004).

5.6. Conclusion

The results suggest that Buffelsdraai and Osindisweni areas are dependent on forest resources for their livelihood sustenance. Therefore, the ecological restoration project was critical for livelihood diversification. In this study socioeconomic and demographic factors such as age, gender, total monthly income, years of education, household size, and access to forest resources significantly influenced perceived forest ecosystem products income. Perceived restoration employment income was significantly influenced by gender, age, and years of education. Notably, household size and total monthly income were not significant determinants of perceived restoration employment income. Regarding services, goods, and incomes, forest resources continue to play a significant role in rural communities in developing countries. The primary elements causing a difference in how households perceive the influence of ecological restoration on their livelihoods can be considered and integrated into the planning, designing, and implementation of programs and activities of ecological restoration, according to the study's findings. The provision of alternative livelihood opportunities and access to higher education aimed at diversifying young people's livelihood portfolios are crucial in reducing the utilization of forest ecosystem services, thereby protecting forests for future generations. These measures help to foster a balance between the utilization of forest ecosystem resources and ecological restoration.

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CHAPTER 6: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1. Introduction

The conclusions derived from the study are presented in this chapter. The chapter offer recommendations for potential policy plans as well as topics for further research.

The lack of research on the factors impacting households' participation and perceptions of the tree and ecological restoration efforts in South Africa, a developing nation, served as both inspiration and motivation for the study. The goal of the study was to identify the household's perceptions of the trees in its surroundings as well as the factors that affect these perceptions and the household's decision to participate in the tree and ecological restoration projects. These perceptions were analysed concerning the three research questions. In summary, a variety of factors may have an impact on how people perceive their environment and several significant inferences can be drawn from the findings.

6.2. Summary

This thesis is divided into six chapters: an introduction, a literature review, three empirical chapters, and a conclusion. Because the same data was utilized in all three empirical chapters, the study area and data collection procedures are described in the third chapter, which all the following chapters refer to. Chapter 2 covers a review of literature on the definition and discussion of ecological restoration; ecological restoration potential for climate change; evaluation of ecological restoration; tree, forest, and ecological restoration programs; benefits associated with voluntary participation in ecological restoration programs; factors affecting participation in the tree, forest, and ecological restoration; environmental concern and awareness; determinants of environmental perception and attitude; households' values of trees, woods and forests; ecological restoration contribution to households' livelihoods; benefits of natural capital to peoples' livelihood; the influence of environmental education on attitudes and behaviour; and measurements of perceptions.

Chapter 3 focuses on the effect of households' characteristics on their participation in ecological restoration programs. The effectiveness of ecological restoration is seen as being largely dependent on community participation. Understanding factors influencing household participation in restoration assists restoration managers in creating ecological restoration programs that encourage community participation. The results showed that socioeconomic and

demographic factors such as age, gender, years of education total monthly income statistically significantly influence positively, whereas household tenure affects negatively. The study concludes that socioeconomic and demographic elements, which were very important in the research area, should be incorporated into the Provincial and local municipality policy framework on ecological restoration projects.

Chapter 4 focuses on the determinants of households' perceptions of their environment. Environmental perception is a crucial topic of study. Concern for the environment is expanding as a result of increased environmental damage brought on by human activity. Without knowing how people perceive the environment, effective environmental management cannot be achieved. Interactions between people and nature are frequently influenced by their beliefs, perceptions, and environmental concerns. Understanding how environmental perceptions are formed and where knowledge about the environment originates is crucial if human behaviour toward the environment is to be modified. The results showed that socioeconomic factors and household demographic characteristics such as age, gender marital status, and dwelling type were significant predictors of households' perceptions of trees in their environment.

Chapter 5 assesses the perceived impact of ecological restoration on household livelihoods in peri-urban and rural areas of the eThekwini district, South Africa. The study of the contribution of income from the forest to rural livelihoods has gained traction in recent years. In emerging regions, environmental resources are crucial to rural livelihoods. In particular, ecological resources like fuelwood, wild foods, medicinal plants, and building materials are essential to the survival of peri-urban and rural communities. In addition to using forest resources to meet their basic requirements, people in developing countries also trade these resources to make a sizeable profit. The study concludes that households that depend on forest income as a matter of necessity could potentially be impacted by restrictions to access to forest resources, and it suggests that households' socio-economic factors should be considered in ecological restoration interventions to apply target-oriented actions and policing activities.

The study recommends that the socioeconomic and demographic elements, which were very important in the research area, should be incorporated into the government policy framework on ecological restoration projects. These factors could encourage local people's involvement in ecological restoration projects if they are thoughtfully incorporated into policy formation.

6.3. Conclusions

Demographic and socio-economic aspects all have an impact on the participation of local communities in the tree and ecological restoration projects. These important variables may promote or deter local communities from taking part in ecological restoration programs. Socioeconomic and demographic factors that comprise, age gender, total monthly income years of education, and household tenure were the main factors influencing household participation in the tree and ecological restoration projection. Notably, marital status and employment status were not significantly associated with household participation in the tree and ecological restoration project. Gender, age, marital status, and dwelling type were all significant predictors of households' perceptions of trees in their environment. Notably, employment status, level of education, access to electricity, and access to clean water had no significant influence on households' perceptions of trees in their environment.

The results suggest that respondents are dependent on forest resources for their sustenance. The ecological restoration project was critical for livelihood diversification. In this study socioeconomic and demographic factors such as age, gender, total monthly income, years of education, household size, and access to forest resources significantly influenced perceived forest ecosystem products income. Perceived restoration employment income was significantly influenced by gender, age, and years of education. Notably, household size and total monthly income were not significant determinants of perceived restoration employment income. Regarding services, goods, and incomes, forest resources continue to play a significant role in rural communities in developing countries.

6.4. Policy recommendations

Policymakers should consider the following interventions in light of the study findings. The socioeconomic and demographic elements, which were very important in the research area, should be incorporated into the government policy framework on ecological restoration projects. These factors could encourage local people's involvement in ecological restoration projects if they are thoughtfully incorporated into policy formation. Strong local community participation in the tree and ecological restoration programs and positive local community associations with the forests are essential for forest conservation and ensuring the long-term viability of the forests. The local community needs to be consistently encouraged for tree and ecological restoration

projects to succeed. To achieve this, incentives should be raised, access to potential sponsors should be improved, social group formation encouraged, and infrastructure should be improved.

Understanding the drivers of households' perceptions towards trees in their environment, which have ramifications for human–nature relationships, is one method academics can encourage sustainable and pro-environmental behaviour. This study has laid a foundation for the comprehension of some sociodemographic factors that may influence environmental behaviours, such as involvement in environmental initiatives like recycling, reforestation, afforestation, and climate change mitigation and degradation, which is important for developing environmental planning and strategy. Understanding the drivers of environmental perceptions and attitudes, which have ramifications for human–nature relationships, is one method academics and policy makers can encourage sustainable and pro-environmental behaviour.

The primary elements causing the difference in how households perceive the influence of ecological restoration on their livelihoods can be considered and integrated into the planning, designing, and implementation of programs and activities of ecological restoration, according to the study's findings. On the other hand, policies ought to encourage neighbourhood communities to take an active part in ecological restoration projects. The provision of alternative livelihood opportunities and access to higher education aimed at diversifying young people's livelihood portfolios are crucial in reducing the utilization of forest ecosystem services, thereby protecting forests for future generations. These measures help to foster a balance between the utilization of forest ecosystem resources and ecological restoration. Last but not least, this research has added to the body of knowledge about the impact of ecological restoration on household livelihoods, particularly in Southern Africa where the complex relationship between people and their immediate environment is now more recognized.

6.5. Limitations of the study and directions for further studies

This study points to a wide range of topics that require further investigation. However, there are limitations. One such limitation relates to the sample's origins, which were limited to one major metro area and exclusively represented the eThekwini region. Due to the limits of the survey data, some socio-demographic factors, such as religion and political affiliation, which are major drivers of environmental behaviour in other studies, were not included in this study. The direct questions and the way they are worded might potentially miss other sentimental and emotional responses and actions that could also affect how concerned people are about the environment.

They do, however, provide insight into some of the socio-demographic variables that affect how people and nature interact in a socio-demographically varied region like South Africa's eThekwini district. Future studies should evaluate the factors influencing the willingness and extent to participate in tree and ecological restoration projects in South Africa.

Appendix 1: Questionnaire

An evaluation of the factors that influence households' participation and perceptions of the tree and ecological restoration in eThekwini districts, South Africa

College of Agriculture, Engineering and Science

School of Agricultural, Earth and Environmental Sciences

Discipline of Agricultural Economics

Questionnaires

SONI SIPHELELE

217038547

Master of Science in Agriculture (Agricultural Economics)

Name of the Area:…….

1: Socioeconomic factors and household characteristics

1.1. Gender of the household head

Male	
Female	

1.2: Who is the head of the household?

Father	
Mother	
Grandfather	
Grandmother	
Child Headed Household	
Other (specify)	

1.3: Age of the household head in years

……

1.4: Marital status of the household head

Married	
Unmarried	
Divorced	
Widower	
Widow	
Cohabiting	
Other (specify)	

1.5: Employment status of household head

Employed	
Self- employed	
Unemployed	
Other (specify)	

1.6: What is the source of income for the household?

Source of income	Yes	No	Amount in Rands
Old age grant/ pension			
Child grant			
Salary from employment or self-employed			
Sales of forest products			
Other (specify)			

1.7: What is the household's total monthly income estimated to be in Rands?

……

1.8: What is the household size?

……

1.9: How many years of education did you complete in total?

……..

1.10: Household dwelling ownership

Owned or Mortgage	Rented	Rent free	Other (specify)

1.11: What kind of main house your household own?

Assets	Yes	No
Shack house		
Mud house		
Brick house		
Stone house		
Other (specify)		

1.12: Does the household have access to electricity?

Yes	No

1.13: What kind of energy is mainly used in your household?

Source of energy	Yes	No
Fuelwood		
Paraffin		
Gas		
Other (specify)		

1.14: How long has the household lived in the area?

……..

1.15: Does the household have access to clean water?

Yes	No

1.16: What is the main source of drinking water in your household?

Source of water	Yes	No
Tap		
Rain water		
Borehole		
Other (specify)		

2: Project involvement and awareness

2.1: Have you heard about the restoration project?

Yes	No

2.2: If yes, where have you heard about it?

Television	
Radio	
Friend	
Social media	
Community project meeting	
Other (specify)	

2.4: Are you involved/ participating in the restoration project?

Yes	No

2.5: If involved, what is your role in the restoration project?

Role	Yes	No
Employed		
Selling seedlings		
Other (specifiy)		

2.6: If not, are you willing to participate in the restoration project?

Yes	No

2.7: Do you think the restoration project is a good idea?

Yes	No

2.8: Is the restoration project progressing according to plan to meet its objectives?

Yes	No

2.9: What are the restoration project objectives?

Objectives	Yes	No
Creating job opportunities		
Plantation of trees		
Increasing assess to forest ecosystem goods and services		
Climate change mitigation		
Increasing utilization of forest ecosystem goods and services		
Enhanced food security		

3: Buffelsdraai Landfill Site Community Restoration project and household livelihoods

3.1: Has your household obtained any income from the restoration projects

Yes	No

3.2: Is there anyone in your household working on the restoration projects?

Yes	No

3.3: Has your household obtained income from selling the following forest ecosystem resources from the restoration project?

Forest ecosystem resources	Yes	No
Fuelwood		
Wild fruits and vegetables		
Medicinal plants		
Materials to build houses		
Thatch grass		

3.4: What benefits has your household obtained from the restoration project?

	Yes	No
Increased income		
Employment		
Enhanced food security		
Increased access and availability of forest ecosystem goods and services		
Other (specify)		

3.5: Has your household perceived any improvement on the provisioning forest ecosystem services from the restoration projects?

Regulation forest ecosystem services	1: Strongly Agree	2: Agree	3: Neutral	4: Disagree	5: Strongly disagree
Erosion control					
Flood control					
Air quality					

3.6: Which of the following forest ecosystem services do you perceive as benefits from trees?

Forest ecosystem services	Yes	No
Fuelwood		
Medicinal plants		
Wild fruits and vegetables		
Thatch grass		
Materials to build houses		
Erosion control		

Flood control		
Air quality		
Other (specify)		

THANK YOU FOR YOUR TIME!!! HAVE A WONDERFUL DAY.