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# ASSESSING THE EFFECT OF SUNLIGHT ON TERRESTRIAL GRASSES IN BOTH OPEN AND SHADE AREAS IN NAGONGERA TOWN COUNCIL, TORORO DISTRICT.

BY

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DEPARTMENT OF BIOLOGY.

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DATE Oct/2024

**DECLARATION**

I **WABENDO BONIFACE** hereby declare that this is my original work and has never b
submitted by any other student for degree or any other award in any University or o
institution of higher learning. The information derived from the literature has been
acknowledged in the text and a list of references provided.

*Signature*.................................... Date...14th/08/2024.....

## APPROVAL

The report has been submitted for examination to the Faculty of Science and Education Busitema University with the approval of my supervisor.

**Mr. ODONGO JESSE**

Sign..................... Date...14th/08/2024

## DEDICATION

I dedicate this report to my father Mr. Wabendo Alfred .C., my friends Wawuyile Emma, Mateya Constat and beloved Biology lecturers for the support they have rendered to me throughout the course.

**ACKNOWLEDGEMENT.**

I express my sincere gratitude and appreciation for assistance and encouragement I got from the lecturers and the laboratory technicians in the Biology department of Busitema University, Government of Uganda and friends who made it possible for me to complete my research project.

Above all I thank the almighty GOD who rendered me life and enabled me to carry on with this work, all my friends and Biology class who helped me have a good stay at Busitema University, Nagongera campus.

**Abstract**

Light is an essential factor for the growth and development of plants, including grasses. The effects of light on grasses can vary depending on whether they are exposed to open areas or shaded environments.

Grass receives direct sunlight for the majority of the day in open locations. They are able to carry out photosynthesis, which is how they turn sunlight into energy, thanks to the abundance of light. Because of this, grasses in open spaces typically grow to a shorter height and have a higher biomass than those in shaded locations. Moreover, the increased light exposure encourages the synthesis of chlorophyll, the pigment that gives plants their green colour.

Conversely, because of trees or other structures, grasses in shadowed areas receive less sunlight. Their growth and development are impacted by this decreased availability of light. Compared to their open counterparts, grasses in shaded regions are often tall and have a lower biomass. Moreover, their chlorophyll concentration is reduced.

Furthermore, the effects of light on grasses extend beyond their physical characteristics. Light also influences the reproductive processes of grasses, such as flowering and seed production. In open areas, grasses are more likely to produce flowers and seeds due to the ample sunlight. In contrast, grasses in shaded areas may have limited or no flowering and seed production.

## TABLE OF CONTENTS

# 1 Table of Contents

## LIST OF FIGURES

**CHAPTER ONE.1 INTRODUCTION**.

This chapter covers the background of study, problem statement, research questions, main objective of study, specific objectives of study, significance of study.

## 1.1 Background:

Light is an essential factor for the growth and development of plants. It plays a crucial role in photosynthesis, the process by which plants convert light energy into chemical energy. Different plant species have varying light requirements, and grasses are not exception. Understanding the effects of light on grasses in both open and shade areas is important for optimizing their growth and maintaining healthy growth and landscapes. This research is aimed at the impact of light on grasses in both open and shade areas of Nagongera Town council, Tororo district, considering factors such as; light intensity which refers to the amount of light energy reaching a specific area. It is measured in units called lux. Grasses require a certain level of light intensity to carry out photosynthesis effectively. According to a study by (Hart 1974), grasses generally thrive in light intensities ranging from 10,000 to 20,000 lux. Insufficient light intensity can lead to reduced photosynthetic activity, resulting in weak and sparse grass growth, duration of light exposure which refers to the length of time grasses are exposed to light each day. This factor is influenced by the length of daylight hours and can vary depending on the season and geographical location. Research by (Ralph, Durako et al. 2007) suggests that grasses typically require a minimum of 6 to 8 hours of direct sunlight exposure per day for optimal growth. Inadequate light exposure can lead to stunted growth and increased susceptibility to diseases, light quality which refers to the specific wavelengths of light that plants receive. Different wavelengths have varying effects on plant growth and development. Red and blue light are particularly important for photosynthesis, while green light is less efficiently absorbed(Terashima, Fujita et al. 2009). A study by (Strydom, McMahon et al. 2017) found that grasses exposed to a higher proportion of red and blue light exhibited increased biomass and chlorophyll content compared to those exposed to green light.

This highlights the significance of light quality in promoting healthy grass growth. Another factor is hade tolerance: Grasses vary in their ability to tolerate shade, which is characterized by reduced light availability. Some grass species, such as fine fescue (Festuca spp.) and creeping bent grass (*Agrostis stolonifera*), are known for their shade tolerance. Research

(Graber 1931)demonstrated that these grasses can maintain satisfactory growth even in areas with limited sunlight. However, most grass species, including Kentucky bluegrass (*Poa pratensis*) and Bermuda grass (*Cynodon dactylon*), require higher light levels and struggle to thrive in shaded areas and finally effects of shade on grasses; Shade can have several detrimental effects on grasses. Reduced light availability inhibits photosynthesis, leading to decreased carbohydrate production and limited energy for growth. A study by (Solofondranohatra, Vorontsova et al. 2021), showed that grasses grown in shaded areas had lower shoot biomass, shorter roots, and reduced leaf area compared to those grown in open areas. Additionally, shade can promote the growth of moss and other shade-tolerant plants, further competing with grasses for light, water, and nutrients.

## 1.2 **Problem Statement**:

The effects of light on grasses in both open and shade areas have been a subject of interest for researchers. Previous studies have shown that light availability significantly influences the growth and development of grasses (Mitchell 1953). However, there is a lack of comprehensive research comparing the effects of light on grasses in open areas versus shade areas.

One of the main issues facing grass in open and shade areas is the impact of climate change. Rising temperatures and changing precipitation patterns are altering the distribution and abundance of grass species, leading to shifts in ecosystem dynamics. A study by (Ceballos, Davidson et al. 2010) found that grasslands in the United States are experiencing a decline in productivity due to these changes, with implications for both wildlife and agriculture.

In Uganda, agriculture plays a crucial role in the economy, with livestock farming being a significant contributor. However, one of the challenges faced by farmers is the lack of adequate lighting in open and shed areas for their animals. This lack of light can have a detrimental effect on the growth and health of the grasses that animals rely on for food.

Some of the researches conducted in Tororo district also showed that grasses require sunlight to photosynthesize and grow. However, in pen and shade areas, the natural light may be obstructed by buildings, trees, or other structures, leading to reduced light exposure for the grasses. This can result in slow growth, yellowing of leaves, and overall poor health of the grasses

Therefore, this research aims to explore the influence of light on grasses, both in open and shaded areas in Tororo district Nagongera town council, highlighting the implications for ecosystem dynamics and management practices.

## 1.3 Main objective of study.

To investigate how light affects grasses in both open and shaded areas, and how it plays a major role in their growth and survival.

## 1.4 Specific objectives of the study.

1. To determine the growth rate of grasses in open areas compared to grasses in shaded areas.

2. To understand how different light conditions, impact the growth and development of grasses.

3. To explore the potential benefits or drawbacks of growing grasses in shaded areas compared to open areas.

## 1.5 Research questions.

1. How does light intensity affect grass growth in open areas?

2. How does shade affect grass growth and development?

3. What are the specific adaptations of grasses to low light conditions?

## 1.6 Significant of the research.

The significant of this research study is divided into the following sections.

### 1.6.1 Contribution to the field.

This study contributes to the field by highlighting the importance of light in grass growth and development. By comparing the effects of light in both open and shade areas, researchers can gain a better understanding of the specific light requirements of different grass species. This knowledge can be utilized in various applications, such as landscaping, agriculture, and urban planning, to optimize grass growth.

### 1.6.2 Potential implication of research.

Researchers have recently become interested in the impact of light on grasses, both in shade and open regions. Comprehending these impacts can have noteworthy consequences for multiple domains, such as horticulture, landscape architecture, and ecological preservation.

This research has wide-ranging consequences. By carefully controlling the amount of shade and sunlight that grasses receive, farmers may maximize crop yields by having a thorough understanding of how light affects grasses. With this information, landscapers may create parks and gardens that encourage the establishment of healthy grass in both open and shady places.

Additionally, the results of this study have consequences for environmental preservation. Grasses are essential for maintaining biodiversity, stopping erosion, and stabilizing the soil. Conservationists can create plans to preserve healthy grass by knowing how light affects grasses populations in various habitats, ensuring the preservation of ecosystems.

### 1.7 Justification for the importance of research.

Firstly, understanding how light impacts grass growth and development can help in optimizing agricultural practices. Farmers can make informed decisions regarding the placement of shades or structures to ensure that grasses receive adequate sunlight for optimal growth.

Secondly, this research can also have implications for landscaping and gardening. By understanding the specific light requirements of different grass species, homeowners and gardeners can create more successful and visually appealing landscapes.

Lastly, studying the effects of light on grasses can contribute to our understanding of ecosystem dynamics. Grasses play a vital role in various ecosystems, and their growth patterns can influence the overall health and biodiversity of these habitats.

# 2 CHAPTER TWO: LITERATURE REVIEW

This chapter presents the related literature on the topic of study based on the specific objectives of study. Several studies have investigated the effects of light on grasses, shedding light on the importance of this environmental factor.

According to (Turner and Knapp 1996), grasses in open areas receive direct sunlight for a longer duration, resulting in higher photosynthetic rates and increased biomass production. This is due to the ability of grasses to capture and utilize light energy efficiently. In contrast, grasses in shaded areas experience reduced light intensity, leading to lower photosynthetic rates and limited growth.

Furthermore, research by (Cayssials and Rodríguez 2013) suggests that grasses in shade areas exhibit adaptations to low light conditions. These adaptations include elongated stems and larger leaves, which enhance light capture and maximize photosynthetic efficiency. However, prolonged exposure to shade can lead to reduced growth and vigor in grasses, as they may struggle to meet their energy requirements.

In addition to light intensity, the quality of light also plays a significant role in grass growth. A study by (Baldwin, Liu et al. 2009) found that grasses exposed to full spectrum light, which includes all wavelengths, exhibited better growth and development compared to those exposed to limited spectrum light. This highlights the importance of providing grasses with a balanced light spectrum for optimal growth.

## 2.1 Effects of Light on Grass Growth:

Light is a primary factor influencing grass growth and development in open areas, grasses receive direct sunlight, which promotes photosynthesis and enhances growth rates. Studies have shown that increased light availability leads to higher biomass production, increased leaf area, and improved nutrient uptake in grasses (Cruz 1997). Conversely, grasses in shaded areas experience reduced light intensity, resulting in decreased photosynthetic rates, elongated stems, and reduced biomass production (DIAS-FILHO 2000).

## 2.2 Physiological Responses of Grasses to Light:

Light quality and quantity significantly influence grass physiology. Research has demonstrated that grasses respond differently to various light wavelengths, with red and blue light being particularly important for photosynthesis and growth (Kochetova, Avercheva et al. 2023). Additionally, light availability affects leaf morphology, chlorophyll content, and stomatal conductance, all of which impact grass water-use efficiency and overall health (Ghorbanzadeh, Aliniaeifard et al. 2021).

## 2.3 Ecological Interactions:

Light availability plays a crucial role in shaping grassland ecosystems by influencing plant competition, herbivory, and species composition. In open areas, grasses often outcompete other plant species due to their ability to efficiently utilize available light resources. However, in shaded areas, grasses may struggle to compete with shade-tolerant species, leading to shifts in community composition (da Silveira Pontes, Maire et al. 2015). Furthermore, light availability affects herbivory rates, as shaded grasses may be more susceptible to grazing due to reduced defensive compounds and compromised growth (Wise and Abrahamson 2007).

Therefore, this literature review highlights the significant influence of light availability on grasses in both open and shaded areas. Understanding the effects of light on grass growth, physiology, and ecological interactions is crucial for effective land management, restoration efforts, and conservation strategies. Further research is needed to explore the specific mechanisms underlying these effects and to develop targeted approaches for optimizing grassland productivity and biodiversity in different light environments.

## 2.4 Practical Applications

The knowledge gained from studying the effects of light on grasses in both open and shade areas has practical applications in various fields. In agriculture, understanding the impact of light on grass growth can aid in optimizing pasture management and forage production. In landscaping and turf management, manipulating light conditions can be utilized to enhance the aesthetic appeal and quality of lawns and sports fields. Additionally, in horticulture, the use of supplemental lighting systems can extend the growing season and improve the productivity of grasses in controlled environments (Paradiso and Proietti 2022)

## 2.5 Growth rates of grasses

Recent studies have investigated the growth rate of grasses in open and shade areas, shadding light on the mechanisms underlying plant responses to environmental conditions. In a study by (Tegg and Lane 2004), the growth rates of three grass species (*Poa pratensis, Festuca arundinacea, and Lolium perenne*) were compared in open and shaded environments. The researchers found that *Poa pratensis* exhibited the highest growth rate in open areas, while *Festuca arundinacea* performed best in shaded conditions. *Lolium perenne* showed intermediate growth rates in both environments, suggesting a moderate shade tolerance.

Another study by (Foster and Gross 1998) investigated the effects of soil nutrient levels on grass growth in open and shade areas. The researchers found that high nitrogen levels promoted rapid growth in all grass species tested, regardless of light conditions. However, phosphorus and potassium levels had a more significant impact on grass growth in shaded environments, where nutrient uptake may be limited. These findings highlight the importance of soil fertility management for optimizing grass growth in different environments.

In a meta-analysis by (Cayssials and Rodríguez 2013), the growth rates of grasses in open and shade areas were compared across multiple studies. The researchers found that grass species varied in their responses to light availability, with some species showing a preference for open habitats, while others thrived in shaded conditions. Grasses with C4 photosynthesis pathways were more efficient at capturing light in open areas, leading to higher growth rates compared to C3 species (Pinto, Sharwood et al. 2014). However, C3 grasses exhibited greater shade tolerance and maintained growth in low-light environments.

## 2.6 Classification of Grasses.

Grasses belong to the family Poaceae, which is one of the largest plant families, comprising over 12,000 species (Lee, Choi et al. 2020). The classification of grasses is primarily based on morphological characteristics such as leaf structure, inflorescence type, and growth habit. The most common classification system divides grasses into two subfamilies: Pooideae and Panicoideae (Lee, Choi et al. 2020).

Pooideae grasses, also known as cool-season grasses, are adapted to temperate climates and typically thrive in open areas with moderate light conditions. Examples of Pooideae grasses include Kentucky bluegrass (*Poa pratensis*) and fescue grasses (Festuca spp.). These grasses have narrow leaves and a bunch-type growth habit, allowing them to efficiently capture light in open areas (Bonos and Huff 2013).

Panicoideae grasses, on the other hand, are warm-season grasses that are well-suited for tropical and subtropical regions. They are often found in shade areas with high light intensity. Examples of Panicoideae grasses include Bermuda grass (*Cynodon dactylon*) and switchgrass (*Panicum virgatum*). These grasses have broader leaves and a spreading growth habit, enabling them to tolerate high light conditions.

# 3 CHAPTER THREE: RESEARCH METHODOLOGY.

## 3.1 Study site.

Nagongera town council is found West of Tororo district, East of Butaleja district, South West of Mbale district and North East of Bugiri District. The study site covers a total area of about 850 acres (340 hectares) and it is at coordinates of the town are 00◦46'12.0N, 34◦01'34.0"E (Latitude: 07700◦N Longitude: 34.0261◦E. It has an average elevation of 1120m and, annual average temperature of 26.6◦C and annual precipitation of1210mm. The area has a bimodal type of rainfall which begins in March or April with peak in May and June and October to November from December to March the area experience dry spell through occasionally irregular rainfall in the former months. It receives an annual rainfall of about 1082mm with double maxima and a mean annual maximum temperature of 28.9◦C and a mean annual minimum of 16.4◦C

**Types and sources of data.**

The data for this study was collected from 2 main sources, primary source and secondary source. The raw data for this research were from field survey which involves the uses of field measurement while the secondary sources were generated from theses, maps, journals, internets, conference proceedings and other documentary sources.

## 3.2 DATA COLLECTION AND DATA ANALYSIS.

### 3.2.1 Research Design and Sampling strategies.

### 3.2.2 A Comparative Study between Open and Shed Areas.

### 3.2.3 Effects of light on grasses in open areas.

Grass receives prolonged direct sunlight exposure in open spaces. Photosynthesis, the process by which plants transform light energy into chemical energy and produce glucose and oxygen, is encouraged by this copious supply of light. As such, grasses growing in open spaces typically have higher biomass, lush green colour, and robust growth. The pigment known as chlorophyll, which is produced in response to light availability, is important for absorbing sunlight and promoting the growth of grasses which further enhances the grasses' ability to thrive (Burkholder 1936)

### 3.2.4 Effects of Light on Grasses in Shade Areas:

On the other hand, because of trees or other overhead structures, grasses in shade areas receive less light exposure. Their growth and development are impacted by the limited availability of light. The stems of grasses in dark regions frequently grow longer as they reach for the available light. The condition referred to as etiolation leaves grasses weaker and more vulnerable to pests and diseases (Leonard and Szabo 2005). Furthermore, photosynthesis is hampered by the lower light intensity, which lowers glucose production and overall plant vigor.

**The picture below show how  data was collected during the process of sampling.**

*Figure 2 image 2*

***Figure 1 image 1***

*Figure 3 image 3*

### 3.2.5 Adaptations of Grasses in Different Light Conditions:

Grasses have evolved various adaptations to cope with different light conditions. In shade areas, they possess broad leaves that maximize light absorption. These leaves are often arranged in a horizontal orientation, allowing them to capture sunlight from various angles throughout the day. On the other hand, grasses in open areas tend to have narrower leaves and a more vertical growth habit, enabling them to capture as much light as possible from the limited available sources (Ralph, Durako et al. 2007).

### 3.2.6 Sampling strategies.

When studying the effects of light on grasses in both open and shed areas, researchers employ various sampling strategies to gather accurate and representative data (Jin, Sun et al. 2021). These strategies are crucial in ensuring that the findings are reliable and can be generalized to a larger population.

In this research, I explored some of the commonly used sampling strategies in this field of research.

One commonly used sampling strategy is random sampling. This involves selecting grass samples from both open and shade areas randomly, without any bias (Bengough, Castrignano et al. 2000). Random sampling ensures that every grass sample has an equal chance of being selected, thus providing a representative sample of the entire population. This strategy helped to minimize the potential for bias and ensured that the results can be generalized to a larger area.

Another sampling strategy used is stratified sampling. This involves dividing the study area into different strata based on specific characteristics such as light intensity or grass species. Researchers then select grass samples from each stratum in proportion to its representation in the overall population. Stratified sampling allows for a more detailed analysis of the effects of light on different grass types or light conditions, providing a more comprehensive understanding of the topic (Ralph, Durako et al. 2007).

Lastly, systematic sampling is a strategy that involves selecting grass samples at regular intervals (Dick, Thomas et al. 1997). For example, researchers may choose to sample every tenth grass plant in a row or column. This strategy ensures that the samples are evenly distributed across the study area, reducing the potential for bias and providing a representative sample.

### 3.2.7 Data collection methods.

To understand the effects of light on grasses, I employed various data collection methods. One common method is the use of a quadrat to determine the distribution and abundance of grasses in different light areas in nagongera town council. The quadrat measuring 3 meter by 3 meter was thrown randomly from one area of study and grass species heights where the quadrat landed were measured by use of a tape measure and counted as well. This was repeated in different sites of study.

### 3.3 Data analysis methods.

When studying the effects of light on grasses in both open and shed areas, researchers employ various data analysis methods to draw meaningful conclusions. These methods help in understanding how light intensity and duration impact the growth and development of grasses in different environments.

One commonly used data analysis method is statistical analysis. Researchers collect data on various parameters such as grass height, biomass, chlorophyll content, and leaf area index. They then use statistical tests, such as t-tests or analysis of variance (ANOVA), to determine if there are significant differences between the grasses grown in open areas and those grown in sheds.

All data was collected from $4^{th}$/April/2024 to $25^{th}$/April/2024 and was subjected to Analysis of Variance (ANOVA). This analysis helps identify whether light availability plays a crucial role in grass growth.

Correlation analysis is another technique for data analysis. Researchers take measurements of light duration and intensity at various points in the open and shed areas, then connect this data with the grass growth characteristics. They can ascertain the direction and degree of the association between light and grass growth by computing correlation coefficients. Positive correlations show that better grass growth results from more exposure to light, whilst negative correlations imply the opposite (Hadi 2015).

Furthermore, researchers may employ regression analysis to model the relationship between light and grass growth. They fit regression models to the data, allowing them to predict grass growth based on light intensity and duration. This analysis helps in understanding the specific effects of light on grasses and can be used to optimize light conditions for maximum growth.

The data collected during the grass survey was subjected to different indices such as Shannon and Wiener, Sampson diversity and species relative abundance (RA) was calculated for each species grass species using the following equations:

RA (%) of individual species in a sampled area $= \left(\frac{n_i}{N}\right) X100$

Where;

N= Total number of species in a sampled area,

$n_i$= number of individual species.

Diversity is calculated using Shannon wiener diversity index (Omayio, Mzungu et al. 2019).

$$H^1 = -\sum_{i=1}^{S} piln(pi)$$

Where $H^1$=Shannon-Wiener diversity index.

S= Total number of species in a community;

Pi= proportion of S made of each species;

Ln= natural logarithm.

Species evenness in each community will be determined using Shannon's equitability (EH)

$$E_{H} = \frac{H\prime}{HMax} = \frac{\sum_{i=1}^{S} Piln(Pi)}{\ln(S)}$$

Simpson index (D) was used to determine (diversity) information of species present on the sites.

The Simpson's index is a measure of diversity, which takes into account both species richness, and an evenness of abundance among the species present. In essence it measure the probability that two individuals randomly selected from an area will belong to the same species. The index is given by the formula below.

$$D = 1 - \sum \left(\frac{ni}{N}\right)^2$$

Where ni, is the total number of organisms of each individual species and N is the total number of organisms of all species.

# 4 CHAPTER FOUR: RESULTS.

A total of 9 grass species were each identified whenever a quadrat is thrown five times and there heights were measured using a tape measure in centimetres from both open and shade areas. (Figure 4 and 6). In terms of relative abundances, it was calculated basing on that particular species in a given quadrat then relative abundances within quadrats were summed up and divided by total number of quadrats to get an overall abundance of grass species in both open and shade area. (Figure 5 and 7).

A low Shannon diversity index value was obtained from grass species in shade area while the highest values was obtained in open area. (Figure 8 and 9). The evenness index was calculated for grass species from open and shade areas and the values obtained where 0.9851 (open area) and 0.9166 (shade area) (Figure 8 and 9). The value of equitability ranged from 0 to 1. It’s equal to 1 when all species have the same abundance and tends towards 0 when the near total of flora is concentrated on only one species.

The Shannon-Weiner value is high when it’s above 3.0, medium when it’s between 2.0 and 3.0, low when it’s between 1.0 and 2.0 and very low when it’s is smaller than 1.0.

Generally the Shannon diversity was smaller than 1.0 for both species from open and shade areas (Figure 8 and 9)

The diversity and evenness of grass species was higher in open areas compared to shade areas of Nagongera Town Council. (Figure 8 and 9).

Simpson’s value index D ranged between 0 and 1, where 0 means no diversity while 1 means infinite diversity. The value of D indicates the probability that two randomly selected individuals in a community belong to different species. The higher the value of D, the higher the diversity, while the lower the value of D the less the diversity the community is.

The lowest Simpson index in open area was 0.8054 and 0.8490 in shade area (Figure 8 and 9). The values indicates 80% and 84% probability of diversity in open and shade areas respectively. This implies that shade areas was highly diverse in relation to open areas

**Results showing heights (cm) of species from open** area.

| | Quadrats Heights (cm) | | | | | |
|---|---|---|---|---|---|---|
| Species scientific name | Quadrat 1 | Quadrat 2 | Quadrat 3 | Quadrat 4 | Quadrat 5 | Total |
| *Arundo donax* | 33 | 34 | 27 | 30 | 0 | 124 |
| *Axonopus compressus* | 30 | 28 | 30 | 0 | 25 | 113 |
| *Brachiaria deflexa* | 32 | 24 | 36 | 20 | 30 | 142 |
| *Avena luodoviciana* | 26 | 22 | 19 | 16 | 30 | 113 |
| *Brachiaria reptans* | 29 | 30 | 0 | 0 | 23 | 82 |
| *Chloris bartuta* | 30 | 22 | 40 | 43 | 24 | 159 |
| *Dactyloctenium aegytium* | 0 | 0 | 25 | 34 | 30 | 89 |
| *Desmostacty bipinnata* | 35 | 35 | 0 | 26 | 32 | 128 |
| *Heteropogon contortus* | 24 | 28 | 35 | 0 | 0 | 87 |
| **Total** | **239** | **223** | **212** | **169** | **194** | **1037** |

***Figure 4 Results showing heights (cm) of species from open area.***

**Results showing species abundance, there relative abundances (RA) per quadrat (Q) and overall relative abundances (Overall RA) from open areas.**

| Species scientific name | Quadrat Abundance Quadrat 1 | RA in Q1 | Quadrat 2 | RA in Q2 | Quadrat 3 | RA in Q3 | Quadrat 4 | RA in Q4 | Quadrat 5 | RA in Q5 | Overall RA |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Arundo donax* | 20 | 20.2 | 25 | 21.4 | 18 | 17.0 | 15 | 23.4 | 0 | 0.0 | 16.4 |
| *Axonopus compressus* | 12 | 12.1 | 19 | 16.2 | 13 | 12.3 | 0 | 0.0 | 17 | 25.8 | 13.3 |
| *Brachiaria deflexa* | 8 | 8.1 | 10 | 8.5 | 13 | 12.3 | 12 | 18.8 | 4 | 6.1 | 10.7 |
| *Avena luodoviciana* | 16 | 16.2 | 11 | 9.4 | 15 | 14.2 | 6 | 9.4 | 4 | 6.1 | 11.0 |
| *Brachiaria reptans* | 20 | 20.2 | 9 | 7.7 | 0 | 0.0 | 0 | 0.0 | 10 | 15.2 | 8.6 |
| *Chloris bartuta* | 6 | 6.1 | 15 | 12.8 | 7 | 6.6 | 15 | 23.4 | 18 | 27.3 | 15.2 |
| *Dactyloctenium aegytium* | 0 | 0.0 | 0 | 0.0 | 21 | 19.8 | 10 | 15.6 | 9 | 13.6 | 9.8 |
| *Desmostacty bipinnata* | 4 | 4.0 | 7 | 6.0 | 0 | 0.0 | 6 | 9.4 | 4 | 6.1 | 5.1 |
| *Heteropogon contortus* | 13 | 13.1 | 21 | 17.9 | 19 | 17.9 | 0 | 0.0 | 0 | 0.0 | 9.8 |
| **Total** | **99** | **100.0** | **117** | **100.0** | **106** | **100.0** | **64** | **100.0** | **66** | **100.0** | **100.0** |

***Figure 5 Results showing species abundance, there relative abundances (RA) per quadrat (Q) and overall relative abundances (Overall RA) from open areas.***

**Results showing species heights (cm) from shade area.**

| | Quadrats Heights (cm) | | | | | |
|---|---|---|---|---|---|---|
| Species scientific name | Quadrat 1 | Quadrat 2 | Quadrat 3 | Quadrat 4 | Quadrat 5 | Total |
| *Arundo donax* | 68 | 26 | 0 | 30 | 40 | 164 |
| *Axonopus compressus* | 30 | 44 | 50 | 61 | 38 | 223 |
| *Brachiaria deflexa* | 0 | 68 | 0 | 0 | 0 | 68 |
| *Avena luodoviciana* | 58 | 0 | 36 | 0 | 0 | 94 |
| *Brachiaria reptans* | 37 | 30 | 0 | 52 | 33 | 152 |
| *Chloris bartuta* | 0 | 0 | 68 | 68 | 43 | 179 |
| *Dactyloctenium aegytium* | 0 | 34 | 0 | 0 | 0 | 34 |
| *Desmostacty bipinnata* | 32 | 0 | 38 | 39 | 34 | 143 |
| *Heteropogon contortus* | 45 | 36 | 30 | 0 | 37 | 148 |
| **Total** | **270** | **238** | **222** | **250** | **225** | **1205** |

***Figure 6  Results showing species heights (cm) from shade area.***

**Results showing species abundance, there relative abundances (RA) per quadrat (Q) and overall relative abundances (Overall RA) from shade area.**

| Species scientific name | Quadrat Abundance Quadrat 1 | RA in Q1 | Quadrat 2 | RA in Q2 | Quadrat 3 | RA in Q3 | Quadrat 4 | RA in Q4 | Quadrat 5 | RA in Q5 | Overall RA |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Arundo donax* | 15 | 23.1 | 17 | 23.9 | 0 | 0.0 | 13 | 37.1 | 18 | 30.0 | 22.8 |
| *Axonopus compressus* | 9 | 13.8 | 12 | 16.9 | 8 | 21.1 | 3 | 8.6 | 10 | 16.7 | 15.4 |
| *Brachiaria deflexa* | 0 | 0.0 | 6 | 8.5 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 1.7 |
| *Avena luodoviciana* | 11 | 16.9 | 0 | 0.0 | 6 | 15.8 | 0 | 0.0 | 0 | 0.0 | 6.5 |
| *Brachiaria reptans* | 14 | 21.5 | 4 | 5.6 | 0 | 0.0 | 9 | 25.7 | 15 | 25.0 | 15.6 |
| *Chloris bartuta* | 0 | 0.0 | 0 | 0.0 | 3 | 7.9 | 8 | 22.9 | 6 | 10.0 | 8.2 |
| *Dactyloctenium aegytium* | 0 | 0.0 | 17 | 23.9 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 4.8 |
| *Desmostacty bipinnata* | 7 | 10.8 | 0 | 0.0 | 4 | 10.5 | 2 | 5.7 | 5 | 8.3 | 7.1 |
| *Heteropogon contortus* | 9 | 13.8 | 15 | 21.1 | 17 | 44.7 | 0 | 0.0 | 6 | 10.0 | 17.9 |
| **Total** | **65** | **100.0** | **71** | **100.0** | **38** | **100.0** | **35** | **100.0** | **60** | **100.0** | **100.0** |

***Figure 7 Results showing species abundance, there relative abundances (RA) per quadrat (Q) and overall relative abundances (Overall RA) from shade area.***

**Analysed data of a number of grass species from open areas.**

| Species scientific name | Ni | Overall RA | Pi | lnPi | PilnPi | Pi2 |
|---|---|---|---|---|---|---|
| *Arundo donax* | 78 | 16.4 | 0.1726 | -1.7570 | -0.3032 | 0.0979 |
| *Axonopus compressus* | 61 | 13.4 | 0.1350 | -2.0028 | -0.2703 | 0.0182 |
| *Brachiaria deflexa* | 47 | 10.7 | 0.1040 | -2.2635 | -0.2354 | 0.0108 |
| *Avena luodoviciana* | 52 | 11.0 | 0.1150 | -2.1624 | -0.2488 | 0.0132 |
| *Brachiaria reptans* | 39 | 8.6 | 0.0863 | -2.4501 | -0.2114 | 0.0074 |
| *Chloris bartuta* | 69 | 15.2 | 0.1527 | -1.8796 | -0.2869 | 0.0233 |
| *Dactyloctenium aegytium* | 40 | 9.8 | 0.0885 | -2.4248 | -0.2146 | 0.0078 |
| *Desmostacty bipinnata* | 21 | 5.1 | 0.0465 | -3.0692 | -0.1426 | 0.0022 |
| *Heteropogon contortus* | 53 | 9.8 | 0.1173 | -2.1434 | -0.2513 | 0.0138 |
| **Total (N)** | **452** | **100.0** | | | **-2.1645** | **0.1946** |
| **H'** | | | | | **2.1645** | |
| **D** | | | | | | **0.8054** |
| **EH** | | | | | **0.9851** | |

***Figure 8 Analysed data of a number of grass species from open areas.***

**Analysed data of a number of grass species from shade areas.**

| Species scientific name | Ni | Overall RA | Pi | lnPi | PilnPi | Pi2 |
|---|---|---|---|---|---|---|
| *Arundo donax* | 63 | 22.8 | 0.2342 | -1.4516 | -0.3400 | 0.0548 |
| *Axonopus compressus* | 42 | 15.4 | 0.1561 | -1.8570 | -0.2899 | 0.0244 |
| *Brachiaria deflexa* | 6 | 1.7 | 0.0223 | -3.8030 | -0.0848 | 0.0005 |
| *Avena luodoviciana* | 17 | 6.5 | 0.0632 | -2.7615 | -0.1745 | 0.0040 |
| *Brachiaria reptans* | 42 | 15.6 | 0.1561 | -1.8570 | -0.2899 | 0.0244 |
| *Chloris bartuta* | 17 | 8.2 | 0.0632 | -2.7615 | -0.1745 | 0.0040 |
| *Dactyloctenium aegytium* | 17 | 4.8 | 0.0632 | -2.7615 | -0.1745 | 0.0040 |
| *Desmostacty bipinnata* | 18 | 7.1 | 0.0669 | -2.7043 | -0.1810 | 0.0045 |
| *Heteropogon contortus* | 47 | 17.9 | 0.1747 | -1.7446 | -0.3048 | 0.0305 |
| **Total (N)** | **269** | **100.0** | | | **-2.0140** | **0.1510** |
| ***H'*** | | | | | **2.014** | |
| ***D*** | | | | | | **0.8490** |
| ***EH*** | | | | | **0.9166** | |

***Figure 9 Analysed data of a number of grass species from shade areas.***

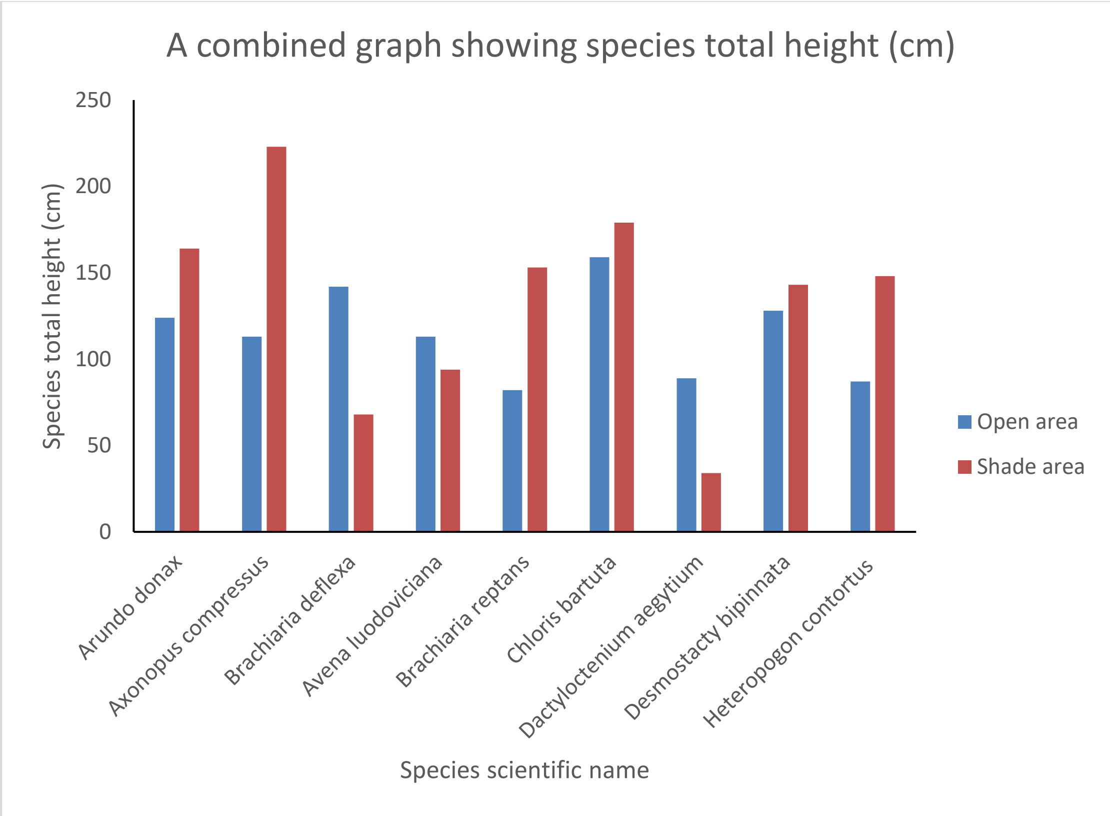


***Figure 10 A combined graph showing species total height (cm)***

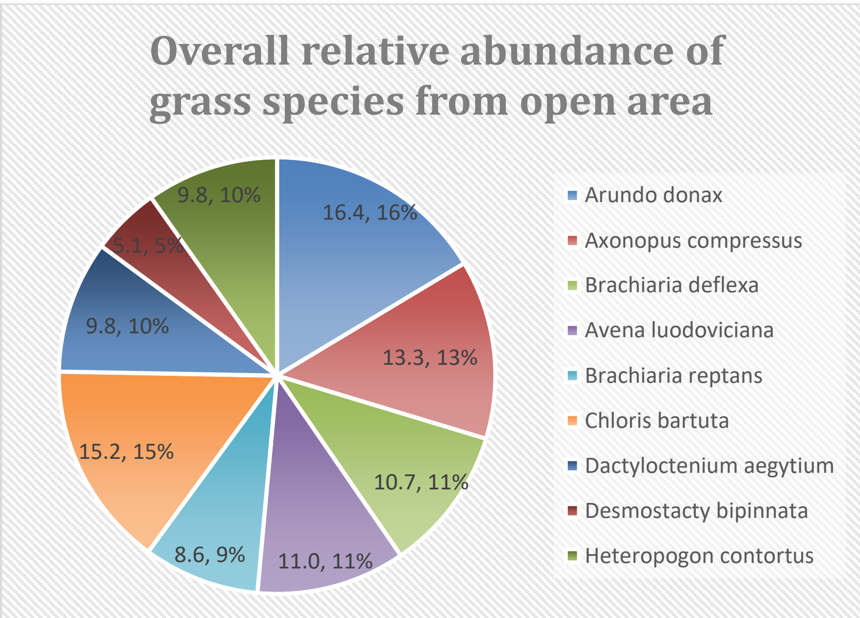


***Figure 11 pie chart showing overall relative abundance of grass species from open area.***

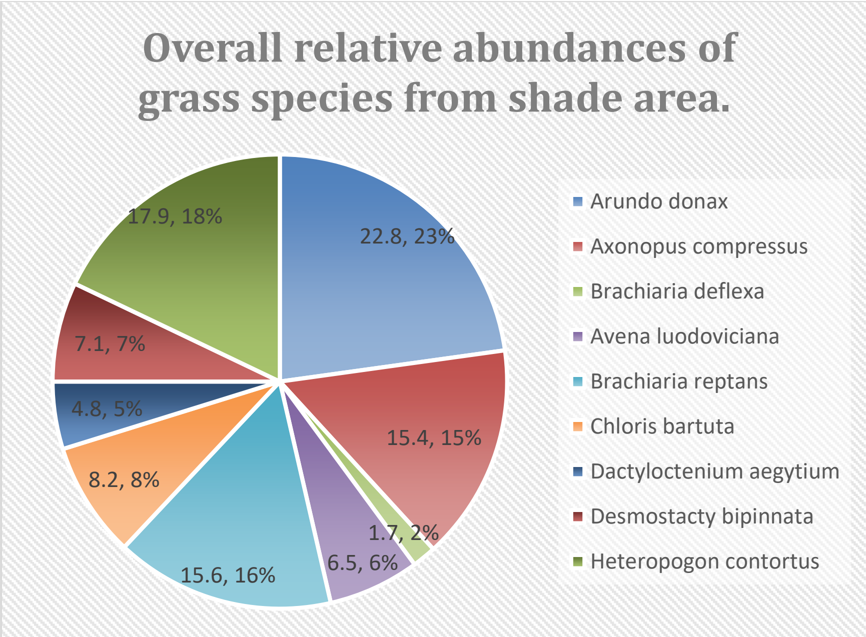


***Figure 12 Pie chart showing overall relative abundance of grass species from shade area***

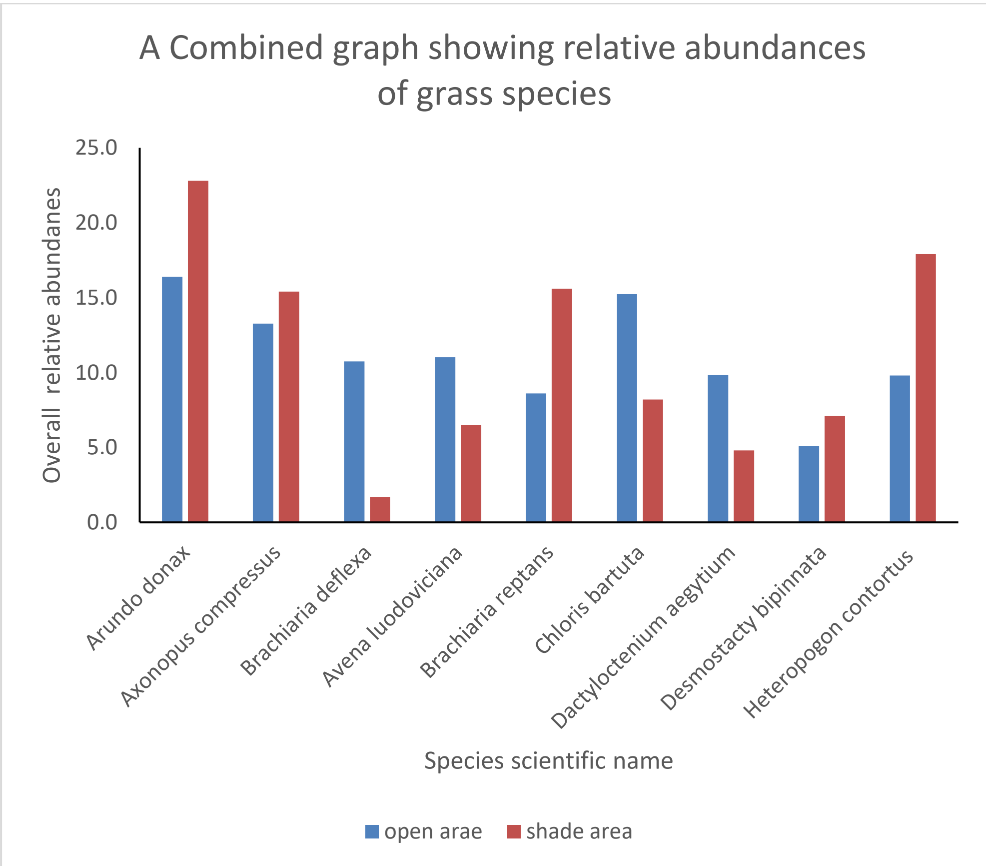


***Figure 13 A combined graph showing relative abundances of grass species.***

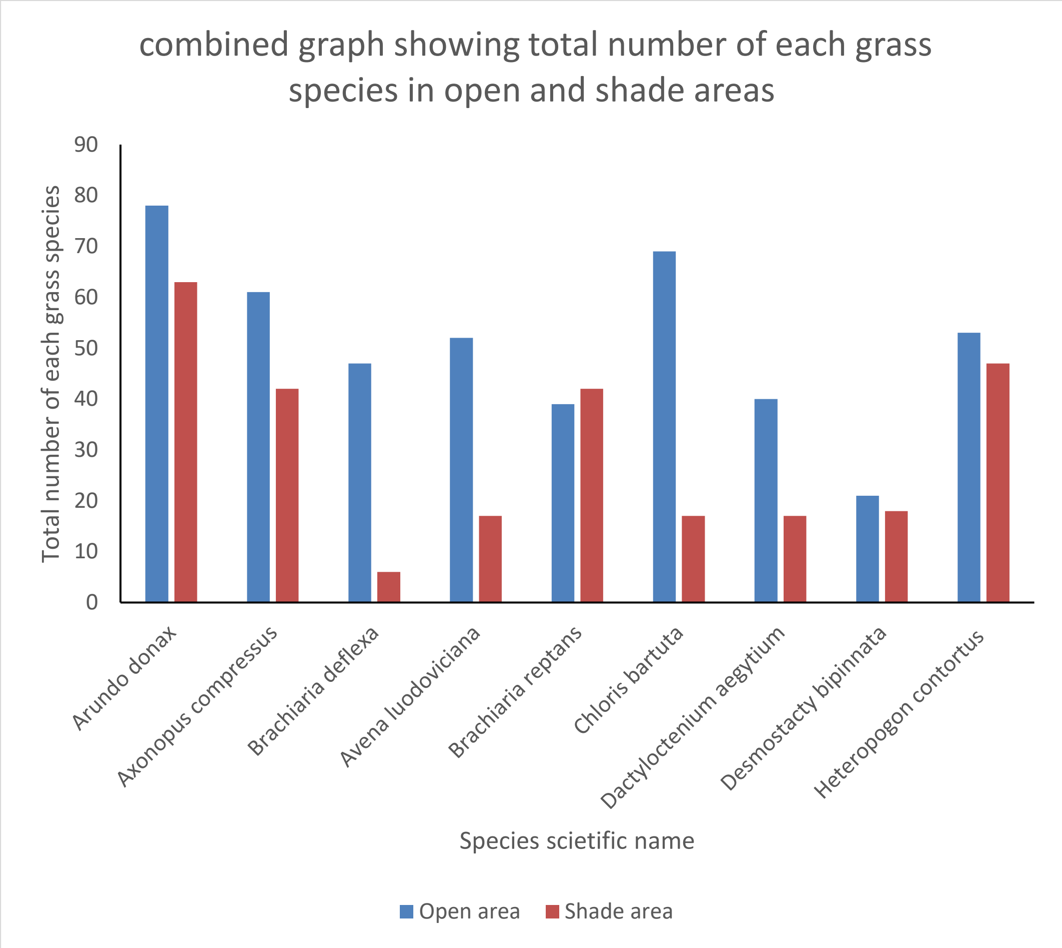


***Figure 14 combined graph showing total number of each grass species in open and shade areas.***

# 5 CHAPTER FIVE: DISCUSSION, CONCLUSION AND RECOMMENDATIONS.

## 5.1 DISCUSSION.

A total of 9 grasses where sampled in both open and shade areas of Nagongera Town Council using a quadrant method, their heights where measured using a tape measure and the number of individual species were also counted. (Figure 4, 5, 6, and 7)

The grass species were distributed according to absence and presence of sunlight and other factors like nutrient and moisture content of the soil. It was observed that most of the grasses from shade areas were taller compared to those from open areas with a few exceptions of grasses from the shade which were short. (Figure 4, 6, and 10)

The grass species from shade areas tend to grow taller than those from open areas because they have evolved to compete for sunlight in low-light environments. In shaded areas there was less direct sunlight available for photosynthesis, so grasses needed to grow taller in order to reach out and capture as much light as possible. This allows them to maximize their ability to produce energy and grow efficiently in conditions where sunlight is limited. By contrast, grass species from open areas had access to more direct sunlight, so they did not need to grow as tall to capture enough light for photosynthesis. Their shorter height helps them to conserve energy and resources, allowing them thrive in the more exposed conditions of open areas.

The few exceptions where grasses in shade areas were observed to be short was due to the fact that in a more dense shaded areas, there was intense competition for limited sunlight, these grass species were able to spread out horizontally and cover more ground, maximizing their chances of capturing whatever sunlight is available.

Another reason was due to the fact that soils in shaded areas was more moist and more nutrient-rich than in open areas, shorter grasses were better adapted to those conditions, maintaining a balance between water uptake and transpiration. This allows them thrive in shaded environments where water availability may be higher.

It was also observed from overall relative abundances of grass species from Open areas that *Arundo donax* was high (16%), followed by *Chloris bartuta* (15%), followed by *Axonopus compressus* (13%), *Brachiaria deflexa* and *Avena luodoviciana* (11%), followed by *Dactyloctenium aegytium* and *Heteropogon contortus* (10%), followed by *Brachiaria reptans* (9%), and lastly *Desmostacty bipinnata* (5%) which was the smallest. (Figure 11 and 13)

In shade area, the overall relative abundances of grass species were *Arundo donax* (23%), which was the highest followed by *Heteropogon contortus* (18%), followed by *Brachiaria reptans* (16%), followed by *Axonopus compressus* (13%), followed by *Chloris bartuta* (8%), followed by *Desmostacty bipinnata* (7%), followed by *Avena luodoviciana* (6%), followed by *Dactyloctenium aegytium* (5%) and lastly *Brachiaria deflexa* (2%) which was the smallest overall relative abundance. (Figure 12 and 13)

All the species totals were calculated by summing up all the numbers of each individual species in the five quadrat and it was observed that grasses from an open area had a highest number (452) compared to that from shade area (269). (Figure 8, 9, and 14). The total number of species was high in open area because of more direct sunlight, which supports a wider range of grass species that require high light intensities.

### 5.2 CONCLUTION.

The findings of this study highlighted the distribution, species richness, diversity and abundance of grass species in both open and shade area of Nagongera town council Tororo district in Uganda. The study gives a clear knowledge and information on grasses species which grow in both open and shade areas.

From the results obtained, it was observed that grasses from shade areas grow taller compared to those from open areas. This was due to the presence of large and tall plants which prevented direct sunlight from grass species under them creating a more competition and the only way grasses had to stretch themselves and grow tall as compared to those from open areas. Furthermore it was observed that in open areas, large number of individual species were present as compared to those from shade areas. This was also due to factors like favourable light availability and also shaded areas tend to have more stable and uniform conditions, which support a more limited range of species adapted to specific conditions

### 5.3 RECOMMENTATION.

Grasses should be grown in open areas in an environment with direct sunlight because sunlight tries to make grasses healthier than those in the shade which tries to struggle for the limited sun-light.

More research should be conducted using more sampling techniques, expanding the geographical scope of the study and also on other factors that affects grass grow to compare the difference in grass diversity and abundance since this research was only based on sunlight due to the short time given.

Both open and shade areas should be given conservation priority to promote biodiversity of grass species since grasses play very important role in the ecosystem as discussed in the research study

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