Investigation of the pastoralists'perception and adoption of silvopastoral system in Gishwati -Mukura landscape .

By

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Declaration

I declare that this dissertation is the result of my own work and has not submitted for any other degree at University of Rwanda or any other institution

Signature…….. Date……

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Signature……. Date……

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Dedication

This dissertation is dedicated to the family of KAGIRANEZA Alexis my loved father.

Acknowledgement

This study is supported by REMA through LAFREC project.My greatest thanks go to the Almighty God for giving me an opportunity to undertake masters' program at University of Rwanda, College of Agriculture, Animal sciences and Veterinary Medicine, His mercy and His tremendous love to me. I am strongly thanks Prof.jean NDUWAMUNGU for his generously supervision, guidance, encouragement as my Supervisor and lecturer.

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I end up thanking again my family for their financial support and prayers.

Peace of God be with you.

Abstract

People in Gishwati-Mukura are good pastoralists compared to the rest of the country. However, their pastoral areas need to be maintained. REMA through the LAFREC project planted of agroforestry trees species, indigenous species, fodder species on an area of 456.23 ha in four district which were Nyabihu,Rubavu,Rutsiro and Ngororero district. This study aims to investigate pastoralists'perceptions and adoption of silvopastoral systems in Gishwati-Mukura landscape. Field survey was conducted by using semi structured questionnaire,145 respondents were selected where 78 respondents of them were purposive selected as pastoralists and beneficiaries of LAFREC project and the remained 67 respondents were pastoralists but non-beneficiaries of LAFREC project. The results showed that adoption of silvopastoral systems is still low even the trial made by LAFREC project in the area that is showed by none of the respondents adopted silvopastoral systems except beneficiaries of LAFREC project. The adopters those who were beneficiaries of LAFREC project had boundary planting and trees dispersed in pastures as silvopastoral practices.The dominant trees species presented in pastures were *Alinus acuminata,Tithonoa diversifolia,Leucena leucocophala and Calliandra calothrus,*The respondents perceived that Alinus acuminate resisted to fail due to its ability of fast growing, fast sprout, tolerant to invasive and easy management .The adoption of silvopastoral systems was perceived to be challenged by Insufficient fund at 100% by pastoralists,95.17 % of respondents perceived the damage to trees by grazing cattle, on availability of seedlings 62.76 % and limited extensions services 4.83% .Therefore pastoralists can be encouraged in adopting silvopastoral systems through increasing silvopastoral extension services, practical training, follow up to the implemented activities and establishing of the trees nurseries in the study area.

Key words: silvopastoral system, pastoralist's perception and adoption

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List of acronym and abbreviation

ICRAFT: International Centre for Research in Agroforestry

LAFREC: Landscape Approach to Forest Restoration and Conservation project

REMA: Rwanda Environmental Management Authority

SPSs: Silvopastoral Systems

CHAPITER ONE: GENERAL INTRODUCTION

1.1.Background of study

Silvopastoral system s are types of agroforestry systems in which animal production systems are combined with fodder plants (grasses and leguminous herbs shrubs and trees for either animal nutrition or complementary uses (Mahecha & Angulo, 2011). A well designed and implemented silvopastoral system provides leverage points intended to alleviate poverty, provide food security and livelihoods, maintain healthy ecosystems, conserve biodiversity and mitigate greenhouse gas effects through carbon sequestration. There have been many projects initiated to encourage the implementation of silvopastoral systems, including incentives payments for ecosystem services. However, the adoption level of silvopastoral systems is still low. Several studies have been conducted on silvopastoral systems, but very few of them focused on the adoption silvopastoral system (Zabala, García-barrios, & Pascual, 2014).

Silvopastoral practices and technologies present different answer to scarce resources for smallholder pastoralists. Interest within silvopastoral systems has grown over the last two decades however, further studies are encouraged to developing a superior thoughtful of adoption uncertainty and understanding the reason behind the motivation of adopting and pastoralists choices to change the adopted systems(Mercer, 2004).

According to the common reason that led to adoption failure was inadequate attention given to socio-economic factors in the plan and development of silvopastoral systems' project(McNeely & Schroth, 2006). This led to a significant failure of many early agroforestry projects including silvopastoral system because they were not anchored on producing financial benefits for the farmers (Current & Scherr, 1995).

In last few years ago, animal production had unenthusiastic advertisingbecause of environmental degradation. Critics accuse the increasing of livestockwithin the globe had damaged shrubs and forests, augmentedsoil degradation,and has polluted the environment(Mahecha & Angulo, 2011). The harmful impacts were accelerated by decision making even so, there were proposed potential responses to the negatives impacts.

The climate change continuity , worries to degradations the causes of environmental pollution, and competition within market, silvopastoral systems have emergedas a precious alternative for increasing, productivitys,an economic and environmentally preferencebyanimal production in the world (Mahecha &Angulo, 2011). LAFREC project has been piloting silvopastoral interventions in some sites within its operational areas. The research aimed to investigate pastoralits'perception and adoption of silvopastoral systems value in Gishwati-Mukura landscape.

1.2. Problem statement

Deforestation is serious problems in most developing countries, mainly due to subsistence farming and commercial agriculture as indicated by Hosonuma *et al*.,(2012) and the agriculture systems are becoming susceptible to the increase of population and the decrease of agricultural land ICRAF(2007).These cause land degradation like frequent drought, soil fertility depletion, landslide which will affect both community's livelihood and livestock. Also silvopastoral systems strategy to alleviate the problems faced is not adopted despite its benefits.

Previous studies of farmers 'views of agro forestry systems have focused on the question whether farmers adopt agroforestry design or do not adopt it, and haven't take consideration on their perception of the new design after adopted it ,Kiptot *et al.,(*2004).There is another realy possible option which can be taken when the adoption doesn't meet the expectations which is discontinuance (parthasarathy and Bhattacherjee,1998).Therefore, this study intended to find out the pastoralists'perception and adoption of silvopastoral systems and the reasons why pastoralists can discontinuance the adoption of silvopastoral systems as it known to be good more than open pasture or pastures without trees.The results of this study would be helpful to the guidelines in the adoption and strategies for its expansion in future not on in Gishwati-Mukura landscape but also in other areas with similar climatic conditions areas of the same problems.

1.3. Study objectives

1.3.1.Overall objective

The overall objective of this study was to assess farmers'adoption and perceptions of silvopastoral systems in the Gishwati-Mukura landscape.

1.3.2.Specific Objectives

1. To assess pastoralists'perception on the benefits of adopting silvopastoral practices in Gishwati-Mukura landscape.

2. To investigate constraints of adopting silvopastoral practices in Gishwati-Mukura landscape.

3. To determine dominant tree species and their attributes preferable in silvopastoral systems in Gishwati-Mukura landscape.

1.4.Research Questions

1. What is the farmers' perception on the uses and benefits of adopting silvopastoral practices in Gishwati-Mukura landscape?
2. What are the constraints of adopting silvopastoral practices in the study area?
3. What are the dominant species and their attributes preferable in silvopastoral systems of Gishwati-Mukura landscape?

CHAPITER TWO: LITERATURE REVIEW

2.1. Silvopastoral Systems

Silvopastoralism involves the inclusion of trees, shrubs and other vegetation on degraded land, to improve social and ecological benefits(Pérez et al., 2006).The degradation in pastures is limited by adopting silvopastoral practices (Lorenz & Lal, 2014), due to the increase in landscape protection and its great role of adding nutrient elements to revival depleted soil fertility through the decomposition of falling leaves ,some trees species which have capacity of fixing nitrogen inclusion of legumes that fix nitrogen to the soil and some trees with the ability of pumping nutrients with the ground as well nutrient recycling. Ruiz *et al*. (2003) described the silvopasture as a biological system under dynamic and constant development.

Its development contains various ages, and it is recognized by the change of its parts, including the soil itself in its structure and arrangement, the livestock, the trees, the key grass rangeland, the flora, the fauna and that of the soil, the reusing of nutrients, the livestock production and its derivatives, the abiotic and the anthropogenic variables, among others of financial character.

In silvopastoral systems, trees or shrubs, livestock production compatibly with the soil.

2.2. Silvopastoral practices

Silvopastoralism involves the inclusion of trees, shrubs and other vegetation on degraded land, to improve social and ecological benefits. These benefits include mitigation of climate change,improvement of water filtration, enhancement of soil retention, improvement in farmers'

production and economic well-being, and the enhancement of biodiversity conservation (Devendra & Ibrahim, 1999). Based on the functions and arrangement of trees the categories of silvopastoral systems are: 1) Live fences, 2) dispersed trees in pastures, 3) fodder banks, 4) grazing in forest and fruit plantations.

2.3. Benefits of silvopastoral systems

Silvopastoral systems comprise of shurbs or trees and domesticated animals production inside the land, producing financial and beneficial advantages to the pastoralist while securing the biological capital (Montagnini, 2008).The combination of trees and livestock allow pastoralists to increase productivity of the pasture land without taking consideration on pasture to increase pasture profitability without relying upon costly saleable data sources.

The mixture of some grasses with shrubs which provide fodder augment dietary value to the animals, whereas the decomposition of leaves from trees stimulates cycling of nutrients, preventing soil degradation, and improve soil fertility (Murgueitio et al., 2006). Cattle suffer less stress when grazing under the shade of trees when compared to the treeless rangelands; because of grazing peaceful accompanied with good respiration systems, all of these have impacts on milk and meat productivity. Silvopastoral systems sometimes encourage job creation; therefore can improve well being of rural people and produce extra benefits like fire wood production, lumber production and fruit. Compared to treeless rangelands, silvopastoral systemsalso supply extra ecosystem services.

The biodiversity is favored by silvopastoral systems through creating composite shelter which sustain the diversity of trees and livestocks, is good shelter for macro and microorganisms and augment linkage among forest segment (Pagiola, Rios, & Arcenas, 2010).Silvopastoral systems sequester more carbon than rangelands which are not containing trees and store it more profound and more lastingly (Calle, 2009).The mixture of grasses and trees holds soil and water, securing watersheds and soils from degradatio (Murgueitio et al., 2006).

The mature trees, cycle nutrients fast and shelter suit to diverse wildlife. Eventually, silvopastoral systems can sustain productivity in many years compared to pasture without trees, and the pressure to cutting forests is minimized Steinfeld *et al.*, (2006).

2.4.Adoptability of Silvopastoral Systems

Decision-making in social-ecological systems is complex and considerate what feature motivate these choices and is point of reference for drawing successful and well-organized preservation strategy (Common & Stagl, 2005). Regardless of whether there is the possibility to make better financial conditions and create nearby and worldwide environment services (Zabala et al., 2014), implementation rates for silvopastoral systemsare still low because of two major motives. First, establishment expenses where as funds accessiblity is low, and profits on the speculation can be remiss for a quite while.

Instant,silvopastoral systems sometimes become mind boggling so their selection is hazardous when data and specialized help are lacking(Murgueitio et al., 2006). Projects wanted to maintain the appropriation of silvopastoral need to address both of these impediments. Prescient models were utilized to look ata the connection between's quantifiable outer factors over which the pastoralists have little control and adoption rates in their area(Mercer, 2004). The factors are assembled into five classifications: household inclination, asset endowment, showcase motivating forces, biophysical qualities and believed hazard and vulnerability (Pattanayak, Mercer, Sills, & Yang, 2003). More than outer factors, adoption choices additionally dependent variables, for examples, individual inspirations and impression of the cutting edge frameworks. Thus, understandings of the result of a silvopastoral system encouragement exertion necessitate examination of these individuals factors that work at personal level.

2.5.Impact of the silvopastoral systems on the environment

Silvopastoral systems are environmentally agreeable option in contrast to ordinary pasture of the similar territory domesticated animals, fodder plants and trees(Mahecha & Angulo, 2011).It is production system that demonstrate the significance of having dairy cattle frameworks good with the ideas of practical advancement (Murgueitio et al., 2006),that can be neighborly with the administration of natural decent variety on the grounds that silvopastoral systems is increasingly tough and versatile to atmosphere change(Devendra & Ibrahim, 1999).

Research centers,governments and currentrly prioritizing the assessment and appraisal of silvopastoral options in the tropics. These alternatives offer the accompanying natural services :increase of production and nature of rangeland rebuilding of corrupted soils, improvement of

water resources, sequestration of carbon and gases with greenhouse effect biodiversity protection.

CHAPITER THREE: .MATERIALS AND METHODS

3.1. Study area description

Gishwati-Mukura landscape is located in the northwestern part of Rwanda. The mean slope gradient of the study area is 35 % at an elevation from 2000m to 3000m above sea level, from longitude $29^0 21' 40'' W$ to $29^0 28' 50'' E$ and latitude $1^0 36' 52'' N$ to $1^0 52' 17'' S$ (Uwimana, 2007). It is shared by four districts Rutsiro, Ngororero,Nyabihu and Rubavu.Figure 2 show the map of Gishwati-Mukura landscape.

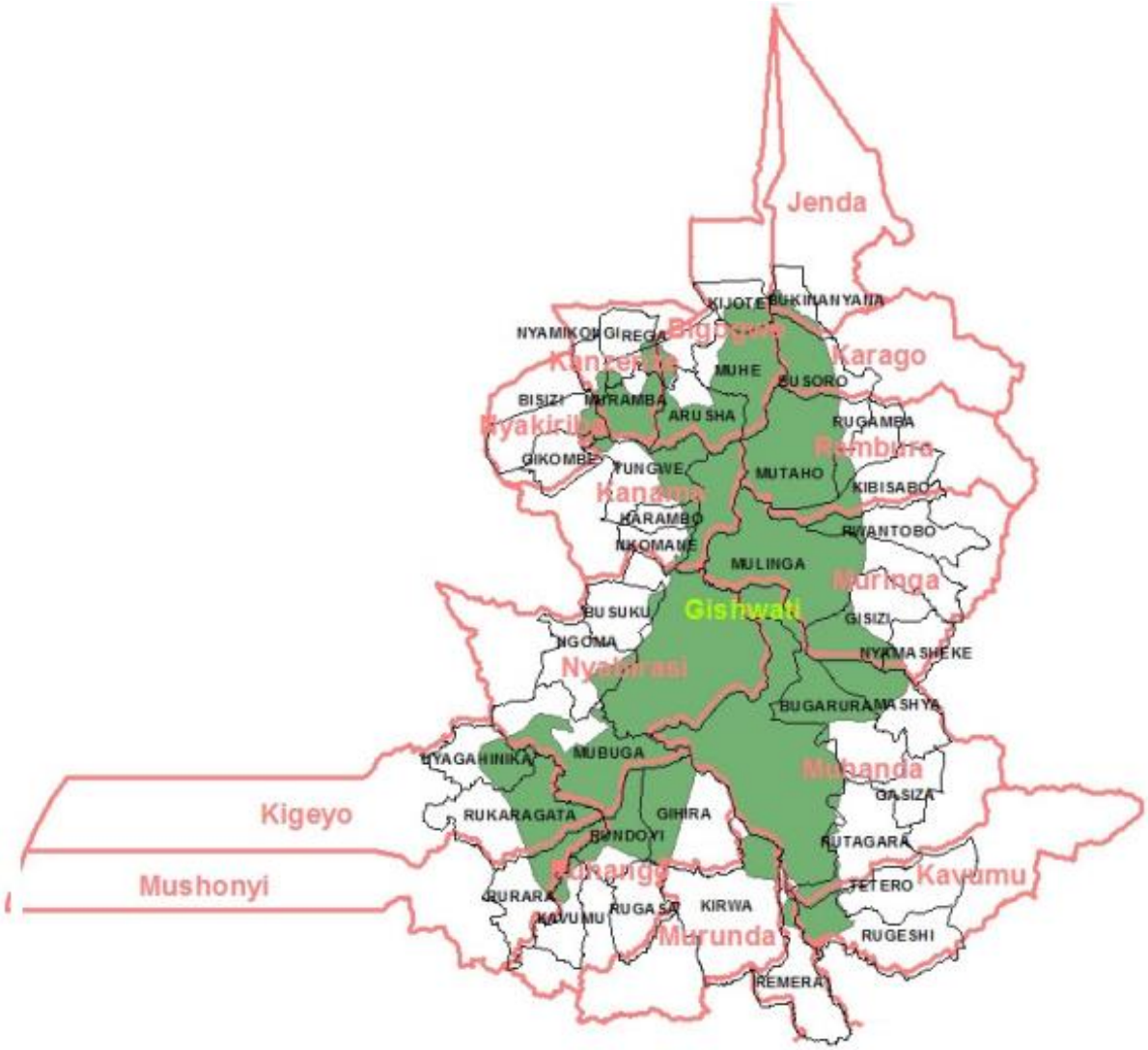

Figure 1: Map of Gishwati

3.2.Target Population

This study will focus on the farmers,silvo-pastoralistand key informantsin Gishwati-Mukura landscape.Located in Ngororero,Nyabihu,Rubavu and Rutsiro particularly in silvo-pastoralism beneficiaries'sectors.

i. Respondents distribution

The table below summarizes the distribution of respondents Gapfunsi,Arusha,Nkomane,Nyabira site were selected because they were beneficiaries of silvo-pastoralismduring LAFREC intervention of rehabilitation sylvo-pastoral area while Gasiza,Rega,Musabike and Ngoma cells are selected as non sylvo-pastoral area and they will be considered as control**.**

Table 1: Location of the study area

District	**Sector**	**Site(sylvo-pastoral area)**	**Site(non sylvo-pastoral area)**
Ngororero	Muhanda	Gapfunsi site	Gasiza cell
Nyabihu	Bigogwe	Arusha site	Rega cell
Rubavu	Kanama	Nkomane site	Musabike cell
Rutsiro	Nyabirasi	Nyabirasi site	Ngoma cell

3.3.Sample design and sampling technique

I will use Simple random sampling to select households for questionnaire survey.As described in Table 1,in each district there is one beneficiary sylvo-pastoral sector , in each sector there is site of sylvo-pastoral area and in each site households will be surveyed using a semi-structured questionnaire (the estimation of number of households will be made through the formulae described in the next section) and I will interview 70 households which are not beneficiaries of sylvo-pastoralism within the cells(non sylvo-pastoral area)as control described inTable 1.Finally,I will interview 15 key informants (District forest officer, veterinary officer, cell executive secretary, social economic development cell).

3.4.Sample size calculataion

The formulae below has been used to calculate sample sizefrom the household population size in the cells described in Table 1.

$n_o=\frac{F^2(p)X(1-p)}{T^2}$(1)

Where: F=value (e.g. 1.96 for 95% confidence level)

P=percentage of picking up a choice,expressed as decimal(0.5used for sample size needed)

T=confidence interval,expressed as decimal(0.05)

$n=\frac{no*pop}{pop+no-1}$(2)where:pop=population(number of households),n=sample size

(Bill Godden,2014).

3.5.Data collection methods

A semi-structured Questionaire was developed for the purpose and Community consultations in the form of focus discussions were used.

The data for the study were collected in the following steps:

- Identification of respondents:Age,education level of respondent and,livelihood(Source of main income,experience in livestock activities).
- Silvopastoral practices: Species planted,design,management.
- Perception:Level of awereness on silvopastoral practices.
- Constraint and Benefits:Limiting factorsin planting agroforestry tree species,diffuculty'level within planting and planting fodder trees,level of diffuculty found in planting the trees and perception on the benefits.
- Status of silvopastoral practices :Direct observation of tree height and qualitative observation about their health quality(good,medium,dead).

4. Data analysis

The data collected were coded and analyzed using STATA. Descriptive statistics were included frequency distribution and percentage tables of common silvopastoral practices, benefits of

silvopastoral systems, challenges faced in adopting silvopastoral systems and pastoralists suggestion to faced challenges of adopting silvopastoral systems.

5. Expected results

The results below were predictable in this research :

(1) The adoption level of silvopastoral practices will be assessed in the selected households (for example the number of trees and species planted in pastures;farm size)

(2) Assessment level of farmers'perception about uses and benefits of silvopastoral practices to meet local communities'needs

(3) Cconstraints limiting adoption of silvopastoral practices and proposed strategies to deal with them in the study area

(4) Status of current silvopastoral practicesin terms of surviving tree height and health quality in LAFREC pilot areas.

CHAPITER FOUR: RESULTS AND DISCUSIONS

This chapter presents the results in different sections regarding to perception and adoption of silvopastoral system in Gishwati and Mukura landscape

4.1. RESULTS

4.1.1. Demographic characteristic of respondents

4.1.1.1. Gender

The results obtained show that in sample size of 145 household head, 96.55% head of household were men while 5 % head of household were men as indicated in table.The outcomes are in accordance withh Kiptot *et al.,* (2014) asserted that female are constrained by cultural norms and restrictions resources 2014)

Table 2: representation of gender of the respondents

Gender	Frequency	Percent
Female	5	3.45
Male	140	96.55

4.1.1.2 Education

The result in tables below reveals that education level of respondents were categorized in 87.59 % of illiteracy, 8.97 % of primary, 2.07% of secondary and 1.38% of college or university. This implies that the adoption of silvopastoral is limited by low education of household as schooling increase ability to understand innovation. The results are supported by Khasa *et al.,(*2017) agreed that educated are prerequisite for adopting different agroforestry systems

Table 3: Representation of education level of respondents

Education	Frequency	Percent
Illiteracy	127	87.59
Primary	13	8.97
Secondary	3	2.07
College or University	2	1.38

4.1.1.3. Age

The table below summarizes the age class of the respondents where 2.76% of the respondents were falling in 29-49 age class and 97.27 of the respondents were falling in 49-Above age. The results indicated that silvopastoral

Table 4: Representation of age of respondents

Age	Frequeny	Percent
29-49	4	2.76
49-Above	141	97.27

Similar results were found by Lunelli *et al*., (2016) reported that farming experience increase the adoption of agroforestry systems including keeping animal in rangelands also tenancy of land , ability to invest increase the adoption of silvopastoral practices

4.1.2. Perceived benefit of silvopastoral systems

The following tables summarizes the results regarding to pastoralists'perception on the benefits of adopting silvopastoral practices in Gishwati-Mukura landscape.the table below shows that 17.24 % of the respondents perceived that silvopastoral systems can control soil erosion,45.52 % of the respondents perceived that silvopastoral systems can be used in fencing , 12.41% perceived that can be used as trees for selling , 9.66 % of the respondents perceived that silvopastoral practices can used fodder production purpose, 6.21 % of the respondents were aware for shade proving and the remaining 8.97 % of the respondents perceived that silvopastoral systems can beautify the area.

The results are support by Martínez *et al*.,(2014). The studies demonstrated that silvopastoral systems kept up soil pH and some essential nutrients.

Table 5: representation of pastoralists 'perception on the benefits of silvopastoral systems

Benefits	Freq	Percent
Control of soil erosion	25	17.24
Fencing	66	45.52
Trees for selling	18	12.41
Fodder production	14	9.66
Provide shading	9	6.21
Beautification of the area	13	8.97
Total	145	100

4.1.3. Challenges for silvopastoral adoption in Gishwati-Mukura landscape

According to the result as shown in table below where 95.17% of respondent revealed that faced risk of damage to trees by grazing animals,62.76% of respondents faced lack of seedlings,100% of the respondents mean all of them faced the challenge of insufficient fund and 4.83% of respondents faced the poor extensions .

The results are in line with Adedayo and Oluronke ,(2014) who revealed that the most faced problems faced for adopting were non-availability of seedlings and lack of technical knowledge due to poor extensions services.

Table 6: Challenges for silvopastoral adoption in Gishwati-Mukura landscape

Challenges	Frequences	Percent	N
Risk of damage to trees by grazing animal	138	95.17%	145
Lack of seedlings	91	62.76%	
Insufficient fund	145	100%	
Poor extensions services	7	4.83%	

4.1.4. Perceived negative impact of silvopastoral systems

The table below summarizes the perceived negative impact of silvopastoral systems where 5.52% of respondents, they didn't know,8.27 % of respondents thought that there aren't negative

impact of silvopastoral systems where as 80 % of respondents mentioned high investment cost of the management of silvopastoral systems and 6.20 % of reducing forage availability.

The results are in the line as Frey et al.,(2012) who revealed that it was not easy to manage trees and livestock when there isn't incentives payments from the government on any other project ,therefore all those hinder the pastoralists to use their own money and revealed that when there is excessive shade can reduce the forage availability for the livestock.

Table 7: Perceived negative impact of silvopastoral systems

Negative impact	Frequency	Percent	n
Don't know	8	5.52	145
No one	12	8.27	
High investment cost on its management	116	80	
Reducing forage availability	9	6.20	

4.1.5. Decision maker on adoption of new silvopastoral practices

The table below summarizes results of respondents on decision making for adopting new silvopastoral systems where the results showed that 86.21% of respondent said that government is the main innovator of the new practices while 20% of respondents said that there is partnership between government land owners in adopting new silvopastoral systems.

Table 8: Decision maker on adoption of new silvopastoral practices

Decision maker	Frequency	Percent
Government	125	86.21
Government and Land owner	20	13.79

4.1.6. Pastoralists' suggestions to the challenges facing in adopting silvopastoral systems

The below table summarizes the results of pastoralists' s suggestions to the faced challenges facing the adoption of silvopastoral systems where 53.10% of respondents suggested maximum follow up of activities done by NGOs or Government,5.17% suggested the incentives and

funding the land owner,19.31% of respondents proposed excellent extension services while 7% they didn't have any ideas.

The results supported by Garbach et al.,(2012) reported that payment of incentives can improve conservation practices and dissemination of information about the new innovation which can play a great important on adoption of silvopastoral practices. Also, Pilote et al.,(2017) suggested incentives to the pastoralists is essential in implementation of silvopastoral systems, and also said that through in extension services like training and field demonstration can increase the adoption of silvopastoral systems.

Table 9: Pastoralists' suggestions to the challenges facing in adopting silvopastoral systems

Suggestions	**Frequency**	**Percent**
Follow up of activities done by NGOs or Government	77	53.10
Incentives and Funding the land owner	109	75.17
Extension services	28	19.31
Don't know	7	4.82

4.1.7. The dominant tree species

The table below summarizes the results regarding to dominant trees in silivopastoral area for respondent who were beneficiaries of LAFREC project where 100% of respondents confirmed that in their pastures there were *Alinus acuminata* ,32.05% percent of the respondents confirmed the presence of *Tithonia diversifolia,*14.10% of respondents confirmed the presence of *Leucena leucocephala* and 8.97% of respondents confirmed the presence of Calliandra.

Table 10: Representation of the dominant tree species

Trees species	Frequency	Percent	N
Alinus acuminata	78	100%	78
Tithonia diversifolia	25	32.05%	
Leucena leucocephala	11	14.10%	
Calliandra	7	8.97%	

4.1.8. Perceived attributes of the first dominant tree species

The table below summarizes the results of respondents to perceived attributes of the dominant tree of Alinus acuminata where all 100% of respondents perceived that Alunus acuminate had ability of fast growing, 25.64% of respondents said that it can tolerate to invasive, 21.79% of respondents said that it can be easily managed and 51.28% of respondents perceived that it has ability of fast sprout.

Table 11: Perceived attributes of the first dominant tree species

Attributes	Frequency	Percent	N
Fast growing	78	100%	78
Tolerant to invasive	20	25.64%	
Easy management	17	21.79%	
Fast sprout	40	51.28%	

4.2. Discussion

1. Demographic characteristics of respondents

The majority of interviewed pastoralists were males 99.55%, only 3.45 %were female. Therefore mean that the majority of respondents who engaged in silvopastoral activities in Gishwati landscape were males which shown the disproportion in silvopastoral activity in the study areas as it is explained by the maximum number of males which are involved in silvopastoral activities when compared to the shortage number of females. Likewise this can be clarified the way of life of Rwanda that men approach the land and credit administrations and

ladies in Rwanda will in general be associated with harvest creation for direct nourishment utilization.

Generally, Women are traditionally involved in crop, small animals and forestry as the component of agroforestry but frequently ignored in designing silvopastoral ventures in light of usually held fantasies about their investment in both creation exercises and in open life (Fortmann and Rocheleau, 1985). Ladies' exercises will in general happen close to the home, where they invest the vast majority of their energy because of sex standards, while men participate in those that require longer periods from the family.

2. Perceived benefits of silvopastoral systems in Gishwati rangeland

As described in the table 5 sillvopastoral systems are multifunctional systems because of providing goods and services, the most ranked is fencing with 45.52% when the silvopastoral practices is boundary planting, followed by control of soil erosion with 17.24%,trees selling had 12.41% through selling timbers, fire wood or stalks,9.66% of the respondents confirmed that silvopastoral practices can provide fodder,8.97 % of respondents suggested that SPSs can be good in aesthetic value and final 6.21% of them confirmed that SPSs can improve shade in pastures. The pastoralist emphasized on fencing as the majors benefits of planting tree in their pastures because it help them to identified the boundary of their pastures and to prevent the movement of cattle and can prevent disease transmission from pasture to pasture also live fencing is more affordable compared to stainless materials and can be helpful to rotational grazing (Morgan, 2016)

3. Silvopastoral practices adopted in Gishwati Landscape

The survey shows that the dominant practices were Boundary planting on pastures and Trees dispersed in pastures. Also the results show that the most dominant tree spicies was *Alinus acuminate* adopted by all respondents a 100%, followed by *Tithonia diversifolia* adopted at 32.05%, *Leucena leucocephala* 14.10% and finally *Calliandra colothrysus* 8.97%.The respondents prefer *Alinus acuminate* as most value tree species because of its attributes of fast grow and fast sprout when cut or damaged by cattle, tolerant to invasive agents and its easily management practices. All mentioned criteria make *Alnus acuminate* a superior tree species in

the study area. Nyeko *et al*., (2002) reported that *Alunus acuminate* resist to invasive disease like damping-off.

4. Challenges for silvopastoral adoption in Gishwati-Mukura landscape

According to the results faced by pastoralists are Insufficient fund were ranked 100% among others challenges as the most difficult challenges preventing adoption of silvopastoral practices in Gishwati landscape ,followed by Risk of damage to trees by grazing animals 95.17 % this require maximum effort to handle it by constructing fence around the planted tree which is time consuming and expensive, some time it end up being not effective for preventing cattle browsing ,lack of seedlings 62.76 % and poor extensions services 4.83% .The insufficient fund impair the adoption of silvopastoral practices due to the lack of ability to purchase seedlings, management of silvopasture .

The results are supported by Graves *et al*.,(2017) asserted that the long term nature of silvopastoral system make it difficult in term of labor and capital, also identified lack of information due limited extension services as constraints to the adoption silvopastoral systems.

CHAPITER FIVE: CONCLUSION AND RECOMMENDATION

5.1. Conclusion

This study has shown that the adoption of silvopastoral is still low in Gishwati rangeland due the adopters of silvopastoral systems were beneficiaries of LAFREC project and the adopted silvopastoral practices were boundary planting and trees dispersed in pasture with the main dominant trees species of *Alinus acuminata* ranked as the most presented in the study area,followed by *Tithonia diversifola,Leucena leucocephala* and the less occurred tree species was *Calliandra collothrus*.

Even though both beneficiaries and non beneficiaries of LAFREC project pastoralists perceivrd that the benefits of adopting silvopastoral practices in the region control soil erosion,45.52 % of the respondents perceived that silvopastoral systems can be used in fencing,12.41% perceived that can be used as trees for selling,9.66 % of the respondents perceived that silvopastoral practices can used fodder production purpose,6.21 % of the respondents were aware for shade proving and the remaining 8.97 % of the respondents perceived that silvopastoral systems can beautify the area. Perceived negative impact of silvopastoral systems, the study revealed that 5.52% of respondents didn't know the negative impact of silvopastoral systems,8.27 % of respondents thought that there weren't negative impact of silvopastoral systems where as 80 % of respondents mentioned high investment cost of the management of silvopastoral systems and 6.20 % of reducing forage availability.

The challenges faced by pastoralists for adopting silvopastoral systems were Insufficient fund ranked 100% among others challenges, followed by Risk of damage to trees by grazing animals 95.17 % this require maximum effort to handle it by constructing fence around the planted tree, lack of seedlings 62.76 % for planting or replacing harmed seedlings and poor extensions services 4.83% which is the main reason of lack knowhow and why.

5.2. Recommendation

In sight of the of the mentioned challenges facing the adoption of silvopastoral systems within pastoralists in Gishwati rangeland, the following recommendations can be useful to tackle difficulties to incredible degree.

- Improving silvopastoral extension services in the study area this can play a great role solving the challenges on lack knowhow and why and lack of knowledge on silvopastoral systems.
- Establishments of tree nursery is useful to the challenges of lack of seedlings and can encourage the pastoralists to plant trees in their pastures.
- Choosing of tree species suitable for dissimilar silvopastoral conditions, with taking considerations on identified basis of pedo-climatic conditions and types of grazing animals, this can help to minimize the failure of some tree species.
- Increasing understanding of pastoralists to the decision making process which can affect their choices in order to be successful in their future.

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Questionnaire

SECTION A . IDENTIFICATION RESPONDENTS

Put X signs on collect answer.

Social characteristics of respondent:**Name of the interviewer:**

1.**Age class**

- Below 18 years ☐
- 19-28 years ☐
- 29-49 years ☐
- Above 49 years ☐

2.Gender

- Male ☐
- Female ☐

3.Martial status

- Single ☐
- Married ☐
- Divorced ☐
- Separated ☐

4.Educatioanl level

- Illiterate ☐
- Primary school ☐
- Elementary technical school ☐
- Secondary school ☐
- Higher learning insitttution ☐

Ask a question about how long the individual has been cultivating or managing livestock, how much experience he/she has – this can be one of your independent variables

SECTION B. Silvopastoral Practices

1. What are the most popular silvopastoral practices in this area?.
   i. Live fence
   ii. Protein bank
   iii. Dispersed trees in pastures
   iv. Grazing in forest and crop plantations
2. What are the most agroforestry species preferable in silvopastoral systems in this area?More than species are allowed.
3. From answer "2" what are their attributes?
   1) Fast growing species
   2) Easy managed species
   3) Tolerant to invasive
   4) Good appreance
4. What are the most popular treatments done in the chosen silvopastoral practices?

   i.Prunning
   ii.Thinning
   iii.Pollarding

5.What are the impact of silvopastoral Practices on animal feed demand and supply in Gishwati –Mukura landascape?

6. Identifying the determinants of the farmer's choice of sylvo-pastoral system in Gishwati –

Mukura landascape?

SECTION C.FAMERS'PERCEPTION ON SILVOPASTORAL SYYTEM

1.How do you define sylvo-pastoral system?

1. Which suitable land do you use for sylvo-pastoral practices?

(a) Flat land only [ ] (b) Gentle slope [ ] (c) Steep Slope [ ]

2. If 'b', or 'c' to question 1 above, why does you prefer to farm on the slope?

(a) Less trees destruction by animals [ ] (b) Less harmful invasion on both trees and animals [ ]

(c) Historical reason [ ] (d) Shortage of flatland [ ] (e) other (specify) ----------

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3. Do you think silvopastoral systems have more effects on pastoralist?

(a) Yes [ ] (b) No [ ]

4. Does slyvo-pastoralism area produce more yield than non sylvo-pastoralism area?

(a) Yes [ ] (b) No [ ]

5.. If yes, why? ----------

SECTION D: FARMERS'PERCEPTION OF SYLVO-PASTORALISM IN GISHWATI MUKURA

1. Do you perceive uses and benefits of sylvo-pastoralism in your daily life?

(a) Yes [ ] (b) No [ ]

2. How is the trend of uses and benefits over 2 years?

(a) Increasing [ ] (b) No change [ ] (c) Decreasing [ ]

3 . Justify your answer to the question 2 above which encourage the changes ?----------

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4. Why do you think is the causes of adoption or non-adoption of slyvo-pastoral system in this area?More answers at most four is allowed

1) .....
2) .....
3) .....
4) .....

5.When did you notice that silvopastoral practices had benefits

(a) Beofore LAFREC project

(b) During rehabilitation of sylvo-pastoral area by LAFREC project

(c) After rehabilation of sylvo-pastoral area

(k) other (specify) ----------

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6. If 'a' to question 5 above, how is the trend level of awarenees right now?

(a) Increasing [ ] (b) No change [ ] (c) Decreasing [ ]

7.Do you believe that sylvo-pastoral area can be increased? (a) Yes [ ] (b) No [ ]

8.Where is your main source of income?

1) Off-farm activities
2) Cropping
3) Livestock

9. Compare the outcome of liverstock product nowdays and the past three years.

a) Increasing
b) No change
c) Decreasing
d) I don't have any idea

10.Justfy your answer to the qustion 9if you choose “a,b,orc”

11.If your answer is “d”,why don’t you Know?

12.How have sivopastoral activities in Gishwati - Mukura contributed to the development of this area?

13.How do you think the income of milk production is related to the activities done in silvopastoral system of Gishwati -Mukura landscape?

14.Did you have any access to credit within the last three years?

1) Yes
2) No

If yes,where did you get the credit?

1) Cooperative suported by LAFREC
2) Local group
3) Bank
4) Persons who conducting their activities in the study area
5) Specify if there is other

SECTION F. Constraints and strategy for adoption of silvopastoral approach

1.Who makes the decisions concerning silvopastoral activities? .....

2.Who is maily follow up silvopastoral activities?

a) Husband
b) Wife
c) Children

3.Who decide the uses and adoption of new sylvo-pastoral technologies?.....

4.Choose constraints hinder adoption of silvopastoral practices.

a) Insuficient fund
b) Limited extension
c) Insuficient researchers
d) Limited aid agencies
e) Complexity of silvopastoral practices

5.The following statement summarize the challenge for silvopastoral adoption in Gishwati-Mukura landscape,which is true and false?

a) Inappropriate methodologies
b) Insuficient of institutioanal support for integrated studies
c) Lack of adequate biophsical data for further studies
d) Bad delivering of research results

6.Encicle the collect answer. The following are the the approach that can increases the adoption of silvopastoral in Gishwati –Mukura landascape?

a) Macro-economic and policy studies
b) Land tenure
c) Long-term researchs and its impacts
d) Much effort in economic models and analytical methods
e) Skills in decision making

7.Rank the following proposed appoach on increasing farm adoption on silivopastoral in in Gishwati –Mukura landascape?

a) Improvement in extension as well as participatory research
b) Comprative,cross-site studies
c) Market analyses
d) Better data sets

8.Which are negatives impacts of sylvo-pastoral system did you noticed?

a) I don,t know
b) Anyone
c) Agroforestry tree species takes long time to grow

d) Small amount of outcomes
e) Occupy land which can be used for others activities
f) There is competition between components of silvopastoral system
g) Disputes during its establishment
h) Shelter of invasives which can be harmful to others activities
i) Changes soil texture
j) If there is other specify.....

9.How many kilometers to nearest market?

10.Did you ever have a shortage of forage in the year?

a) Yes
b) No

- If yes,how did you deal with that situation?
- Did you use any alternative of purchasing fodder? 1.yes 2.No
- If yes,What kind of fodder?

SECTION G. THE BENEFITS OFSILVOPASTORAL APPROACH

1.What was the primary reason for silvopastoral approach?

a) Landscape protection
b) Fodder providing
c) Firewood providing
d) Milk yield improvement

If there is others specify.....

2.Which are positive effects of silvopastoral system did you noticed?

Benefits	Tick the correct	Grading
Anyone		
Land management increased		
Milk production increased		
Milk quality improved		
Health condition of animal improvement		
Money saved on daily fodder		
Feed for suplementary		
Palatable agroforestry species		
Green manure		
Soil fertility improvement		
Soil characteristics improvement		
Control of soil erosion		
Fencing		
Trees for selling		
Stalks		
Beautifaction		
If there is others Specify		