Sveriges lantbruksuniversitet
Fakulteten för veterinärmedicin och husdjursvetenskap

Swedish University of Agricultural Sciences
Faculty of Veterinary Medicine and Animal Science

Fodder to ruminants within agroforestry systems in Rwanda

- Species and management

Linnéa Holmström

Examensarbete / SLU, Institutionen för husdjurens utfodring och vård, **419**

Uppsala 2013

Degree project / Swedish University of Agricultural Sciences,
Department of Animal Nutrition and Management, **419**

Examensarbete, 15 hp
Kandidatarbete
Husdjursvetenskap
Degree project, 15 hp
Bachelor Thesis
Animal Science

Sveriges lantbruksuniversitet
Fakulteten för veterinärmedicin och husdjursvetenskap
Institutionen för husdjurens utfodring och vård

Swedish University of Agricultural Sciences
Faculty of Veterinary Medicine and Animal Science
Department of Animal Nutrition and Management

Fodder to ruminants within agroforestry systems in Rwanda - Species and management

Linnéa Holmström

Handledare:
Supervisor: Kjell Holtenius
Examinator:
Examiner: Ewa Wredle
Omfattning:
Extent: 15 hp
Kurstitel:
Course title: Degree project in Animal Science
Kurskod:
Course code: EX0550
Program:
Programme: Agricultural Science Programme – Animal Science
Nivå:
Level: Basic G2E
Utgivningsort:
Place of publication: Uppsala
Utgivningsår:
Year of publication: 2013
Serienamn, delnr: Examensarbete / Sveriges lantbruksuniversitet, Institutionen för husdjurens utfodring och vård, 419
Series name, part No:
On-line publicering:
On-line published: http://epsilon.slu.se
Nyckelord:
Key words: Agroforestry, Small-scale, Calliandra, Napier grass, Radical terraces

Abstract

Rwanda is one of the poorest countries in the world and about 70-80 % of the population lives in rural areas. The land is strongly affected by land erosion which makes it difficult for the agriculture and food production. Agroforestry is a system where tree plantation is combined with livestock- and crop production. The system provides soil fertilization and binds the soil together. Some of the trees used in agroforestry systems are also used as fodder. The topic the present study was to document the fodder production in rural and small scale farms in Rwanda, and identify potential problems. To answer the research questions semi-structured interviews with open-ended and closed questions were performed. Altogether 13 respondents were interviewed individually and one group interview with 21 respondents was done. The most used fodder were napier grass and leafs and branches from trees, mostly *Calliandra spp.* and the majority of the farmers who were interviewed had fewer than 20 fodder trees which were planted on radical terraces. The benefits since the farmers started with agroforestry were a higher quality of the manure and a slightly increased milk production, probably because of the increased feed amount and quality. The largest difficulty was to get enough fodder during the dry season. To construct radical terraces and plant on them seemed to be a smart way to streamline the land use but still, many farmers needs more trees and an increased land ability to provide them.

Sammanfattning

Rwanda är ett av de fattigaste länderna i världen och ca 70-80% av befolkningen bor på landsbygden. Marken är svårt drabbad av jorderosion, vilket orsakar problem för jordbruk och livsmedelsproduktionen. För att förhindra jorderosion är agroforestry ett förebyggande system och innebär att trädplanteringar kombineras med animalie- och växtproduktion vilket bidrar till näringsrikare och fastare jordar. Några av träden som används inom agroforestry används som foder och i denna studie var syftet att studera foderproduktionen inom småskaliga lantbruk i norra delen av Rwanda som använder sig utav agroforestry och analysera eventuella problem. Studien utfördes med hjälp av 13 individuella intervjuer och en gruppintervju. De fodermedel som främst odlades var napier grass och calliandraträd. De flesta lantbrukare som intervjuades hade färre än 20 foderträd som planterades på radikala terrasser. Djuren utfodrades 2-3 gånger dagligen och förmåner som foderproduktionen hade gett efter att bönderna börjat med agroforestry var högre kvalitet på gödseln och en något ökad mjölkproduktion. Ett av de största problemen var att få fodret att räcka till under torrperioden. Att använda terrasser verkade vara ett smart sätt för att effektivisera nyttjandet av landytan men fortfarande behöver många småskaliga lantbrukare flera eller andra arter av foderträd samt ökad marktillgänglighet för att kunna försörja sig.

Introduction

The population in Rwanda was more than 10 million people in 2010 according to FAO (2010) with more than 400 people per km² and the population still grows (Globalis, 2012; Iiyama, 2012). It is estimated that 70-80 % of the population in Rwanda lives in rural areas and 24% of the population lives in extreme poverty (Nilsson, 2008; Sida, 2012). In Rwanda it is estimated that 90% of the population have their own agriculture and the majority of the farmers only have crops and products for their own household (IPAR, 2009; Ndayambaje & Mohren, 2011). The average amount of cows is 1.7 per farm and the soil in Rwanda has a low pH-level which makes it tough for different fodder species to grow (Pye-Smith, 2010). Rwanda also called “the land of thousand hills” has many farmers settled in the mountain areas and they cultivate the hillslopes. The land has big problems with soil erosion. It is

deteriorated by the rainy season, when the water flows off the hills and moves the fertile soil, this makes it hard to grow anything in these areas (Roose & Ndayizigiye, 1997). In 50 years different organizations like Vi-agroforestry, World Agroforestrycentre (ICRAF) and World Food Programme (WFP) have tried to prevent soil erosion and poverty in different ways. Those organizations also promote agroforestry, which is an effective agriculture system where crop production is combined with tree production and/or animal production. The system has great socio-economic and ecological benefits and suit for small scale farmers who have limited supply of land (Nair, 1991; Harrison). The trees used in the agroforestry systems are often used as fuel to the household and fodders to livestock. Many fodder trees and shrubs are different kind of legumes. Legumes have high nitrogen content and bind the soil together which can protect the cultivated land plots against soil erosion. The trees are also nitrogen fixing and can fertilize the soil which results in higher crop yield. To balance the milk producing cows that needs more protein and energy is the high quality fodder trees a good alternative for concentrate which can be really expensive for the small-scale farmers to get. The result is higher milk yield, and in some cases, higher income (Kitalyi et al., 2005; McDonald et al., 20011). The aim of this study was to document the fodder production and the use of fodder by rural small-scale farmers maintaining ruminants and using agroforestry in Rwanda.

The following questions were raised:

- How common is it that small scale farmers use agroforestry trees as fodder? Which positive and negative effects have been generated?
- What kind of fodder is most common? Which species?
- Which planting method is mostly used?
- Which problems are most common in fodder production? How can they be solved?
- Are there other fodder species, planting- or feeding methods that can be recommended instead and maybe increase the positive effects of the production?

Agroforestry and zero grazing

ICRAF's definition of agroforestry: **"land use systems and practices in which woody perennials are deliberately integrated, both spatial and temporal, with crops and/or animals on the same land-management unit. There are normally both ecological and economic interactions between the woody and non-woody components in agroforestry (Dalc, 2012)."**

There are three types of agroforestry systems. Agrosilviculture; crops and trees are intercropped or shifting cultivation. Silvopastoral; animal production combined with tree production. Agrosilvopastoral; animals, trees and crops are produced together (Dalc, 2012). In east Africa it is usual that farmers have agrosilvopastoral systems and the animals are often zero grazed, this means that they are sheltered in a stall and being fed instead of grazing for free (Pye-Smith, 2010). This makes it is easier to control the animals feed intake and it is common to use crop residues, grasses and other multipurpose trees as fodder. The zero grazing system and the use of fodder trees and grasses can increase the milk yield and in some cases make farmers spend less time and money on the production. This increases the opportunities to keep cows for small-scale farmers. It is also easier to take care of the manure and bring it to the field which increases the crop yields because it works as organic fertilizer (Kitalyi et al., 2005). It has also been seen that zero grazed livestock instead of free grazed help to avoid soil erosion and other damaging of the ground (African Conservation Education Project, 2012).

Fodder

In east African countries, small scale farmers mostly fed with fresh fodder to their animals (Lukuyu, 2007) and it is common to use different grass and tree species (see Table 1). According to the technical handbook for small scale farmers written by Kitalyi et al. (2005) fodder with high quality should grow fast, provide high quality, resist regular pruning, out-compete weeds, remain productive during dry seasons and survive on poor and different sites. Grass is often used as the main forage and legume leaves and branches is a good supplement. Legume species has a high protein content, is nitrogen fixing and makes the soil fertile for crops and other plants (Kitalyi et al., 2005; Pye-Smith, 2010; Mc Donald et al., 2011). To plant fodder on the own farm makes it possible to get a regular input of feed with high quality and makes it unnecessary to buy commercial feeds which saves money for the farmer. There is also possible to sell seedlings and surplus of fodder (Kitalyi, et al., 2005). A farmer in Mount Kenya who was interviewed by Pye-Smith (2010), explained that the milk yield from his cows increased with 2 liters when he gave them home grown protein in form of leaves from calliandra and mulberry. From the plantation of fodder the farmer also sold surplus seeds which generated extra profit (Pye-Smith, 2010).

Table1. Different fodder species and their properties, data is taken from Niang et al. (1996), ICRAFa, b, c, d. (2012) and Kitalyi et al. (2005)

Speices	Length (meters)	Crude protein (%)	Digestibility (%)	Yield DM (tonnes /ha/year)	Grows on altitudes (m asl)	Pruning frequency (weeks)	Nitr. fixing
Calliandra	4-6	24-28	45-60	17	1900	6(8)-12	x
Desmodium						12	x
Flemingia	2.5	14.5-18.3		9	0-2000	6-12	x
Leucaena	5-20	12-28	53-77	8-11	1600		x
M. Scrabella	4-12(20)	24		21	200-2400		x
Mulberry	5-20	19	86	11	3000	8-12	
Sesbania	8	20-25	70		3000		x
Trema	12-18	18.9			2500		x
N. grass	2-3	0.43-14.8	46-72			8-12	

Calliandra *spp*

According to Kitalyi et al. (2005) Calliandra *(C. calothyrsus)* is the most common tree species in east Africa and belongs to the leguminousae family and likes well drained, fertile soils and is sensitive for acid soils and frost. Calliandra can grow until 4-6 meters tall and the trees can be pruned every 8-12 week which means that leafs and young branches are cut. A research in Kenya made by ICRAF, KARI, KEFRI and the Oxford Forestry Institute in the UK, showed that calliandra trees can be pruned every 6 week or 12 week and still generates the same amount leaf biomass. The unavailable protein fraction of the legumes increases with maturation which makes it important to prune the trees in time (Kitalyi et al., 2005). The trees can also be planted on land plots where you are not capable to plant other crops, for example along the slopes of the radical terraces (Pye-Smith, 2010) According to Kitalyi et al. (2005)

the yearly average of biomass can be 17 tonnes dry matter per hectare with a crude protein content between 24-28% and crude fiber digestibility between 45-60 %.

Desmodium *spp*

Desmodium is common in two different species, Greenleaf Desmodium and Silverleaf Desmodium. They are planted together with napier grass and guatemala grass. Desmodium is a legume and grow well in different soil-qualities and climates (Kitalyi et al., 2005).

Flemingia Macrophylla

Flemingia (*F. macrophylla*) is a small deciduous tree which is common in north Tanzania. The leaf retains during the dry period which makes it to a good tree species to grow during this period, the tree is given to cows and goats. The tree can grow up to 2.5 meters and contain 14.5-18.3 % crude protein per kg dry matter. The yield can be 9 tonnes per hectare and year (Kitalyi et al., 2005; ICRAFa, 2012).

Leucaena *spp*

The genus Leucaena also belongs to the leguminousae family and is a small legume tree, growing up to 1600 meters above the sea level in well drained and fertile soils in areas with high rainfall and is sensitive to acid soils. Leucaena can grow up to 5-20 meters tall and there is many different species in tropical areas. The annual yield per hectare can be 8-11 tonnes. The crude protein-content are 12-28 % and the digestibility is 53-77 % depending on specie. For example *L. leucocephala* has a high digestibility. Leucaena is often intercropped and the specie *L. trichandra* is common in east Africa (Kitalyi et al., 2005).

Mimosa Scrabella

Mimosa (*M. Scrabella*) is a tree which can be up to 20 meters tall but is more common to find in a size of 4-12 meters. The tree grows in different kinds of climates, but it is not recommended in dry areas where the average temperature is higher than 23° Celsius and the dry period should not be longer than 4 month. The tree tolerates acid soils and high heights (200-2400 meters) but the soil should be well-drained (ICRAFb, 2012). According to the study done by Niang, et al (1996) *M. scrabella* has 24.9 percent crude protein content and responds well to frequent cutting and produce a high yield of biomass. The study also showed that the amount of leaf biomass after 4 weeks (75 cm high) (2117 DM/g/m/year) was almost the same as after 6 weeks (100 cm high). *M. scrabella* was most preferred by goats and had better properties than calliandra (Niang et al., 1996).

Mulberry (*Morus Alba*)

Mulberry (*Morus Alba*) is very durable tree, even if it does well in moisture climate but can grow at high altitudes. The trees can concur with crops which make it necessary to grow the crops and trees with some distance. Mulberry can be up to 20 meters tall and contains 19 % crude protein and 86% of the dry matter is digestible. The yield can be up to 11 tonnes per hectare and year and the pruning frequency is every 8-12 week (Kitalyi et al., 2005; ICRAFc, 2012).

Sesbania Sesban

Sesbania (*S. sesban*) is a short lived shrub and grows close to water areas such as seasonal ponds, on riverbanks and margins of lakes. It tolerates acid and saline soils and is a nitrogen fixing tree and grows really fast, but already after three times cutting it will die. The tree can

be up to 8 meters tall and live on a high altitude. The crude protein content is between 20 and 25 % and the digestibility is 70% (Kitalyi et al., 2005).

Trema Orientalis

Trema (*T. Orientalis*) is a tree/ or shrub used in the central and eastern parts of Kenya for zero grazing systems. It is a nitrogen fixing specie which is naturally found in riverine forests and forest margins (Kitalyi, et al., 2005). Trema is found in lowland tropics and grows in humid areas for example on flood damaged riverbanks. The tree grows at altitudes up to 2500 meters with the mean annual temperature 20-27 °C (Orwa et al., 2009; ICRAFd, 2012).

Napier grass

Kitalyi et al. (2005) has also written that napier grass (*Pennisetum purpureum*) is the most popular fodder grass in East Africa and is also called elephant grass and recommended for zero grazing systems. It can be up to 2-3 meters high and exist in many different varieties. It grows really fast and densely in good conditions. The soil fertility is a really important factor for the napier grass establishment. Well drained, fertile soils which get a lot of rain are excellent areas for planting napier grass but manure or inorganic fertilizer requires for getting the best condition. The best time to harvest napier grass is after 8-12 weeks of growth or when it is 1-1.5 meters tall when the dry matter digestibility and the nutritive value peak. Napier grass may contain 14.8 % crude protein/kg dry matter (Kitalyi et al., 2005).

Guatemala grass

Guatemala grass is also a common grass species and grows in fertile and well drained soils. It is a perennial and can be up to 3 meters high and is sensitive for drought. The grass is capable for zero grazing systems and has good properties for erosion control around soil and water conservation areas. The fodder quality is a little bit lower than for napier grass. Intercropping guatemala grass with desmodium is recommended to improve fertility and reduce the need for weeding. The best effect is observed if the grass is cut 6 month after planting and it should be cut down to 10 to 15 centimeters from the ground (Kitalyi et al., 2005).

Plantation

Good places for growing fodder are at counter bunds, internal and external boundaries, or in kitchen- or home gardens and around the homestead (Kitalyi et al., 2005). It also seems to be a good alternative to grow fodder on the slopes of terraces. In Rwanda, WFP (2010) did a project with terraces which were constructed for increased food production and the construction also helped to control the soil erosion in these hilly landscapes. The farmers in the project also planted fodder on the slopes between the terraces. To construct radical terraces (see Figure 1) requires much labor and physical work but the effect makes a grand positive difference for the farmers (Yannick Glemarec, 2007; WFP, 2010). Construction of progressive terraces (see Figure 2) does not need as much labor as for radical terracing. They are constructed by ditching and making bunds, the water runs off trough the ditches and the soil slowly builds up the terrace (Yannick Glemarec, 2007). According to Pye-Smith (2010), some farmers in Kenya plant their fodder, both grasses and trees on the edges of the terraces or along the boundaries because of the good soil erosion control and land use efficiency.

Figure1. Radical terraces in the northern province of Rwanda (Photo: Holmström, 2012).

Figure 2. Progressive terraces in the Northern Province of Rwanda (Photo: Holmström, 2012).

It is really important that the seedbed is well prepared and do not have any pests, diseases or unwanted herbs before plantation of different fodder species (Kitalyi et al., 2005). Roschetko's (1994) publication says that fodder trees, legumes and shrubs are often grown in fodder banks. Fodder banks (see Figure 3) are plantations with fodder species that has high quality. To grow fodder in fodder banks is a good way to secure the feed supply, especially during the dry season when it is hard to get enough fodder with good quality. The area between the trees may be used to plant grasses in order to maximize the fodder production (Roshetko, 1994).

Figure 3. Fodder bank with Napier grass intercropped with Desmodium (Photo: Holmström, 2012).

Leguminouses fixate nitrogen by collaborating with bacteria called *Rhizobium,* together they form root nodules that are formed like small balls. These nodules can trap nitrogen from the air and supply the plant and the soil with nitrogen (Texas A&M AgriLife Research & Extension Center at Overton, 2013). Sometimes it is necessary to add extra bacteria in the soil before plantation. This is done by inoculation of the seeds. For example calliandra, lucerne, white clover, leucaena and greenleef desmodium are legume species that require inoculation (Kitalyi et al., 2005).

Many fodder bank system are adapted for zero grazing, the fodder is harvested and carried direct to the livestock. This makes the fodder production effective because the trees can grow without being damaged from grazing animals (Roshetko, 1994).

Harvest

Roshetko (1994) has written about how to harvest a fodder bank with different species in east Africa. A fodder bank should not be harvested until it is 9-12 month old. It depends on the environmental conditions and the growth of the plants when it is time to harvest. If the plants are growing fast it is possible to harvest earlier and if the soil is poor and the plants grow slowly it is better to harvest later. The goal with fodder banks is to make a good soil construction which can be made only if the trees have time to develop deep roots. Before the harvesting it is good for the trees to have a carbohydrate reserve so they easy can be recovered. The recommendation of harvest height of the trees in fodder banks is between 50 to 150 cm. Sesbania leafs should not be harvested lower than 150 cm because it has a high degree of mortality. The cutting height on grasses should be 2-3 cm during the rainy season and 10 cm during the dry season, this because the re-growth should be as good as possible. The first cut after planting grasses should be after 8- 10 weeks. The recommended cutting frequency of the fodder bank is 6-18 weeks, shorter cutting frequencies gives a higher nutritive value of the fodder, but the longevity of the trees is decreased. Before the dry season it is necessary to cut the trees, otherwise it can be a risk that the leaves fall of during the dry season. So it is recommended to cut them between 6-8 weeks before the dry season starts. If the dry season is very long or if the bank is really big, it can be a good alternative to harvest the trees in phases. It makes the feed supply safer during the whole period (Roshetko, 1994). If there is some surplus of fodder during the rainy season it is good to restore it as hay or silage (Kitalyi et al., 2005).

Feeding

Since a large part of the population in Rwanda lives on thier own agriculture and do not have any remarkable income (IPAR, 2009; Ndayambaje & Mohren, 2011), it is probably not possible to do feed analysis. This makes it hard to know exactly how much food the animals need. According to Lukuyu et al. (2007) a large breed as Friesian can eat up to 100 kg of fresh forage and a Jersey can just eat 65-85 kg of fresh forage. According to Kitalyi et al. (2005) intake may be estimated assuming the breeds mainly that the breeds used in East Africa can eat 3 kg dry matter per 100 kg of body weight. For example a cow weighing 350 kg, can eat 10.5 kg of dry matter forage each day but it is good to count with 2 kg more to provide for feed selection and spillage. To give this amount of feed is a good way to secure the feed supply (Kitalyi et al., 2005).

Grass generally has lower protein content than legumes and it is thus good to use some nitrogen-rich legumes as supplement for example lucerne, desmodium, calliandra or leucaena (Lukuyu et al., 2007). According Kitalyi et al. (2005) fresh cut napier grass contains 20-30 % dry matter and legumes and tree leafs contains between 30-50% dry matter. The handbook also says that if 8 kg DM of high quality (harvested after 6-8 weeks) grass is given (26-40 kg fresh napier grass) mixed with 1 kg DM (2-3 kg fresh) of some protein rich legumes or tree leaves, it can result in 10 liters of milk yield each day for a full-grown moderate quality dairy breed, weighing 350 kg in early lactation (8 weeks). It is also necessary to give minerals. If increasing the milk yield is wished, it is necessary to fed with feed supplement or substitute (see Table 2 for example of feed rations). To give 1 kg of concentrate is one alternative, but to

give 3 kg more dry matter of calliandra (6-10 kg fresh) may give the same increase in milk yield.

Table 2. Examples of daily feed ration for a milking cow weighing 350 kg in the early lactation. Medium quality grass is grass that is harvested from land-plots outside the farm. High quality grass is grass harvested after 6-8 weeks. The yield differs between breeds, this examples are for a moderate quality dairy breed. Numbers taken from Kitalyi et al. (2005)

Yield	**Example of feed rations**				
(liters milk/day)		Medium quality grass (kg DM) *(kg fresh)*	High quality grass (kg DM) *(kg fresh)*	Legumes and tree leaves (kg DM) *(kg fresh)*	Concentrate (kg)
1-5	Alt. 1	8 *(26-40)*			
6-10	Alt. 1	8 *(26-40)*			2
	Alt. 2	8 *(26-40)*		4 *(8-12)*	
	Alt. 3		8 *(26-40)*	1 *(2-3)*	
11-15	Alt. 1		8*(26-40)*		2
	Alt. 2		8*(26-40)*	4 *(8-12)*	
	Alt. 3		8*(26-40)*	2 *(4-6)*	1
16-20	Alt. 1		8*(26-40)*		4
	Alt. 2		8*(26-40)*	2 *(4-6)*	3
21-25	Alt 1.		6 *(20-30)*	2 *(4-6)*	6

The feeding trials in Embu showed that a farmer needed 500 trees to feed one cow with 6-10 kg fresh Calliandra each day for a whole year. It also saved 100 US $ per cow and year compared to using concentrate instead of fodder trees. The savings was from transport of dairy meal and increased milk production (Kitalyi et al., 2005). Legumes can have a high content of tannins which binds to the proteins and decreases the digestibility and absorption of the amino acids in the rumen and the small intestine (McDonald et al., 2011). Indigestible proteins are not beneficial for the nutritional supply but the manure is very useful as an organic fertilizer (Pye-Smith, 2010).

Vi-life Programme

Vi-Agroforestry is a nonprofit Swedish organization and one of the organizations that work against poverty and problems in combination with effects of the climate changes like soil erosion, in East African countries around Lake Victoria. Vi Agroforestry support farmers in the rural areas and promotes different agroforestry technologies that consider sustainable development (Nilsson, 2008). They train farmers in planting methods, composting, fish farming and teach them how to efficiently utilize the water and fuel resources (Vi-skogen, 2012).

In Rwanda, Vi-agroforestry is called Vi-life Programme (Vi-life) and was 2004 registered as a non-governmental organization (NGO) in Kigali, Rwanda. Vi-life works in 4 zones in Rwanda, called Kaniga, Bjumba, Rorindo and Gasabo. In total there are 19 000 households connected to Vi-lifes project. All farmers are small scale-farmers and a member of a cooperative, 30 % of them have cows and 70% have goats or sheep. The major reason for having animals is for the manure which makes the land fertile and gives higher crop yields. Secondly, meat from goats and milk from cows makes children stronger and any surplus may be sold and generate an extra income. An important instrumental reason for the poverty in Rwanda is the absence of knowledge. Vi-life educates farmers in terrace construction, animal holding and enterprise, among other things, this conduces to long-stay assumptions for the

farmers and their living. Vi-life also supports the cooperatives and farmers with seeds, technical support and transport of new animals (Kwiringarimana, 2012 personal message; Pinsoru, 2012 personal message).

Method

To get the best information for the study, data were collected during an 8 weeks visit in Rwanda. During these weeks, small-scale farmers connected to Vi-life from the north province of the country were interviewed. The interviews were done together with staff from Vi-life who worked as supervisors and translators. The zone-coordinators suggested farmers to be interviewed in 50 % of the cases, thus they were not randomly selected. The farmers had different backgrounds but all used agroforestry with ruminants involved. In total there were eleven individual interviews and two of those interviewed farmers were leader of a sheep breeding cooperative.

Most of the interviews were recorded and all of them were roughly transcribed. Some of the farmers were visited in their own home, which was a positive experience in terms of to see how the farms worked in the practice. The other meetings were in combination with trainings for small scale farmers that vi-life arranged. Before the meetings, the questions were arranged (see Appendix I for the main questions) but they were changed depending on the situation, and follow-up questions were used if it was needed. The questions were tried to be as open as possible, but closed questions was mostly used.

Some short questions were also asked a group of 21 farmers to improve the statistic material. This group was a mix of people from 5 different sectors. The questions were translated by a Farmer Enterprise Development Officer at Vi-Life. The farmers answered by raising their hands. The questions are attached in the end of the essay (see Appendix I). The answers from the two "groups" of farmers are in most questions mixed and sometimes divided.

To get more information and a more realistic overview of the agriculture and agroforestry system in Rwanda, two zone-coordinators who works for Vi-life were interviewed and they both answered the same questions (see Appendix II).

A lot of information was generated during the guided visits to areas with fodder trees and farms, some conclusions are taken from that information. The Farmer Enterprise Development Officer showed us different tree species that were used as fodder.

Result

The result of the interviews showed that the average was 2.5 cows for each farmer and everyone used zero grazing. All of the asked farmers that had animals (28 farmers) used agroforestry trees as fodder and all of them besides one used calliandra. Nine of them also used other species and shrubs like sesbania, leucena, thephrosia or lucern. Napier grass was used by all farmers and many farmers also used other small grasses as fodder (see Figure 4).

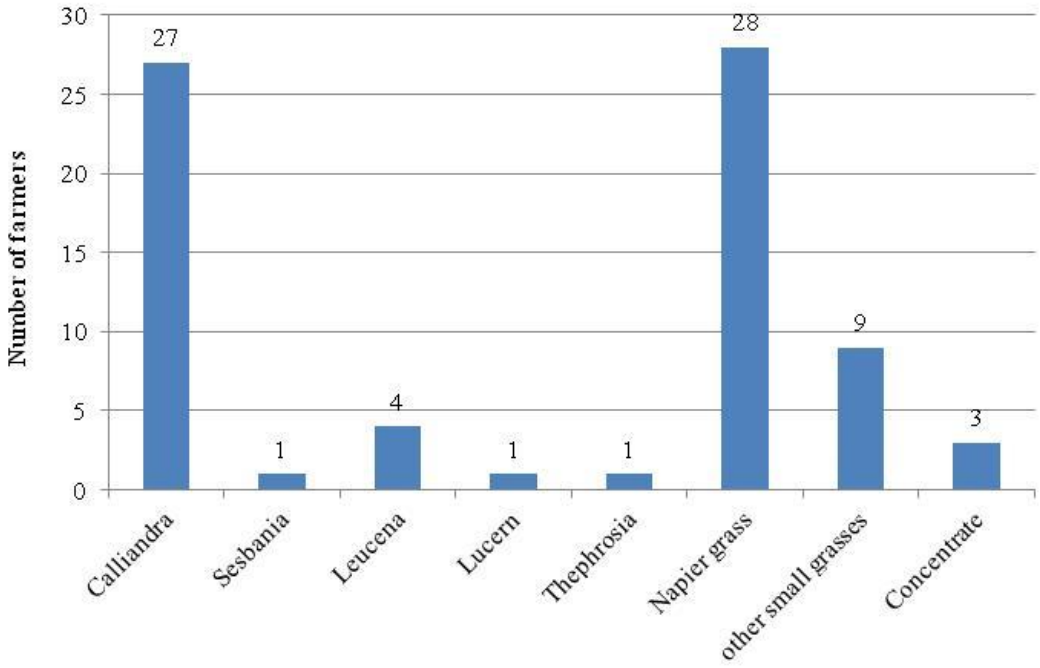

Figure 4. Used fodder species by the interviewed farmers (result from individual and group interview).

As much as 10 farmers (36%) with fodder trees had fewer than 20 fodder trees and 7 farmers (25%) of them had between 20 and 50 trees so in total there were a little bit more than the half (51%) of the farmers that had fewer than 50 trees and for 4 (14%) farms the number of fodder trees was unknown (see Figure 5). One farmer had 250 trees and another had 400 trees and that was the highest number. In average the farmers had 64 planted fodder trees (counted from 24 farmers that had a known number of trees).

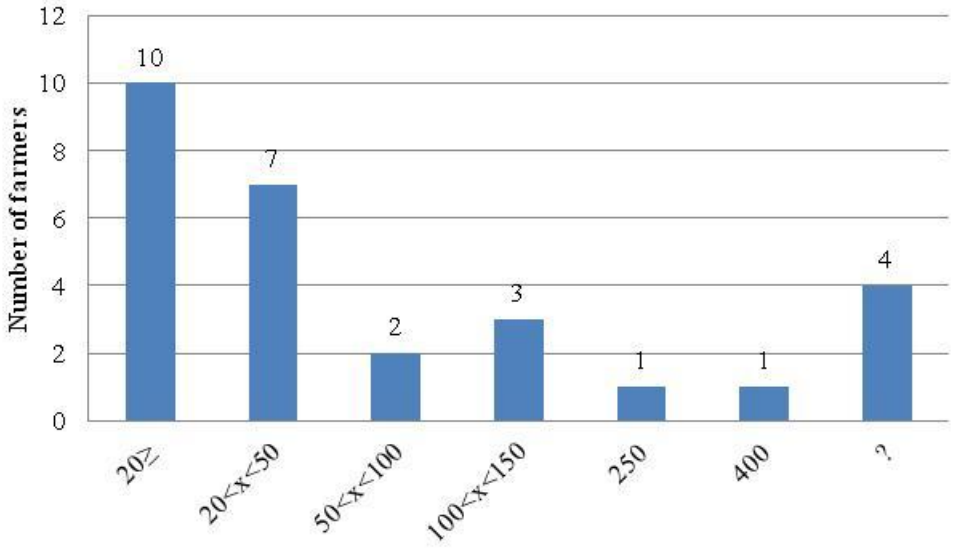

Figure 5. The number of planted fodder trees per farm. Four of the farms had an unknown number of trees.

All farmers grew the fodder on benches of terraces to get the soil stable and fertilized and some grew it around the farm and in fodder banks. The trees were planted with 1 meter space between each other on the slopes and some alternate it with grass (see Figure 6). Most of the farmers lived on a hilly ground and all farm labor was done by hand. The fodder was given direct to the animals, no one conserved it or stored it for a longer time. In average the cows

were fed 2.7 times a day and how much fodder the farmers gave the cows differed and many farmers did not know. One farmer who fed 3 times a day with napier grass and calliandra separately had 85 calliandra trees and gave 35 kg leafs and branches each day at one meal for two cows. But he was not able to feed the cows all year around with calliandra. Another farmer with one cow and 30 calliandra trees estimated to give 100 kg of grass per cow if it was each day was unclear. The farmer planed to give the cow 100 kg of calliandra two times a week during the lactation period. Two other farmers only gave 2-8 kg of calliandra per cow and day and the rest was grasses, how much grass was unclear, it was estimated to "10 meters of land". Five farmers said that they pruned their calliandra trees every third month, and three farmers cut the napier grass one time a month and one farmer cut it with a two month interval. The milk yield differed between the farms but in average it was 12.6 kg/cow/day (see Table 3 for more details).

Figure 6. Radical terrace with planted crops. Napier grass and fodder trees grow on the edge of the radical terrace.

Table 3. A summary of how many times a day the farmers were feeding their cows, how much milk yield they get, what kind of animals they had and how many fodder trees they had per animal and if they used concentrate. The average of feedings each day is counted from the farmers that answered the question which means that farmer number one is not counted in any average calculation

Farmer	Feedings (times/day)	Animals	Yield (liters/cow/day)	Number of trees	Use concentrate
1		13 ewes		?	
2	3	12 ewes, 1 boar			
3	2	2 cows (capacity for 4)	10	120	
4	4	5 cows (milks 2)	12,5	?	
5	3	3 cows (milks 1) 3 sheeps, 4 goats	18	?	X
6	2	1 Sheep ,2 goats		20	
7	2	1 cow, 1 sheep, 1 pig	Home consumption	30	
8	3	5 cows (milks 4)	10	400	X
9	2	5 cows (milks 3, capacity for 10)	22	70	X
10	3	2 cows	3	85	
11	3	1 cow (not milking)		30	

Since the farmers started with agroforestry, the crop yield and the milk production had increased with 1-2 kg for some farmers and the income had also increased. Some farmers got enough fodder that they were able to sell the surplus to other farmers. This made it possible for the farmers to buy more land, animals, or school fees for the children. The use of calliandra trees was also beneficial in terms of that the tree was used as an effective treat against diseases and insects. The agroforestry system had also decreased the soil erosion.

Some problems the farmers had were sick animals and it was hard and expensive to get concentrate and medicine for them. One farmer thought it took long time to get profit and increase the number of animals. One of the biggest problems was to get fodder during the dry season even for the farmers that sold some surplus during the rainy season. Some farmers did not have enough land to plant enough fodder and some cows had a very low milk yield. On one farm the cow generated just enough milk for the calf and for the household and thereafter the calf was sent back to the organization as a payment who donated the cow. In that case no products were sold and did not generate any income for the farmer.

Summary of the interviews with the zone-coordinators

Kwiringarimana Teophile, zone-coordinator for Kaniga district (2012-05-29)

The average number of owned cows in Vi-lifes project was 1- 2 cows. Of all the farmers, 80 % had fodder trees and the most common species was calliandra and leucena. The most common shrubs were desmodium, makuna and lupin. Vi-life promoted farmers to grow trees because they work as good fertilizers for nitrogen and keep the soil stable. The majority of the

farmers connected to Vi-life had less than 100 fodder trees and grew them and the napier grass on the benches of the radical terraces. Vi-life also promoted construction of radical terraces and educated farmers in planting methods, because if the fodder was grown on the benches it did not concur with other crops about the arable land, and it also prevented erosion. It was not common to give concentrate or dairy-meal to the animals because it was expensive and not gainful to give to the local breeds, 70 % of the "Vi-life farmers" had local breeds.

Pinsoru Oscar, zone-coordinator for Gasabo district (2012-05-25)

In Gasabo, 3 was the average number of cows and it was necessary to have that number of animals if the farmers wanted to produce biogas. It was most usual to have local breeds. In whole Rwanda, he estimated that the average was 20 cows for each farm and some farms had over 100 cows. The average number of goats was 2-6 per household. Oscar also said that Vi-life supports farmers to use artificial insemination so they can get crossbreeds with exotic breeds. Every farmer connected to Vi-life used fodder trees and got seeds from the organization. Common trees and shrubs used by the farmers were calliandra, sesbania, thefrosia, leucena, desmodium and lupin, but primary calliandra and sesbania which are short time trees and grow really fast. Oscar estimated that the most common amount of fodder in Gasabo for one cow each day was 25 kg of grass and 6 kg leafs and branches from fodder trees. In Gasabo, not so many farmers had radical terraces but if they had they grew the fodder on the benches of them. Many farmers had progressive terraces and they grew the fodder along the contour lines of the boundaries or together with coffee- or banana plants. It was not so common to give concentrate to the cows because of the high costs. When the farmers grew napier grass, they used seeds or sometimes they took a plant from one place and plant it on another plot so it could spread the roots and multiply. It is hard for the farmers to know how to plant seeds. When Vi-life gives support, sometimes the farmers do not trust the educator, they do not think they need to plant fodder trees. It is also hard because of the competition of land use between crops and fodder. Sometimes it is hard to mix tree seeds with crops because of rules from the government. Vi-life tries to give so many household as possible seeds, but it is not easy and they want to give to all of them.

Discussion

Agroforestry trees were used as fodder by all farmers in the study. Most of them had less than 100 fodder trees each (in average 64 trees) and more than one animal, this agrees with the answers from the interview with Kwiringarimana Teophile. According to the literature (Kitalyi et al., 2005) this is not enough to provide a milking cow a whole year if no concentrate is given. The same literature recommends that at least 500 fodder trees are necessary to complement the napier grass instead of one kilogram concentrate. In this study only three farmers used concentrate. According to the zone-coordinator Kwiringarimana Teophile, the reason for why using concentrates for small scale farmers in Rwanda was uncommon was because of the expensive costs. Using fodder trees seem to be a good alternative because it is cheaper but still amount of feed is not enough to get an optimal milk production. This probably depends of the available land.

Because of that this study was done only with help from Vi-life and farmers connected to Vi-life, it is hard to estimate how common it is that small scale farmers overall in Rwanda use agroforestry trees as fodder. The reason for the farmers to use agroforestry trees may be Vi-life who giving them seeds and educates the farmers in planting. Farmers who do not collaborate with Vi-life probably not use trees, at least not trees with high quality because of the economic opportunities and lack of science.

According to this study, the most benefits with using agroforestry trees as fodder were increased crop yield. This agrees with the literature (Pye-Smith, 2010) which says that trees give high quality manure which works as good fertilizer. The milk yield was increased for some farmers but not for everyone. The reason may be bad quality and lack of fodder. It can also be because of diseases, kind of breed or lack of water. The land erosion had decreased after the start of using fodder trees, which is beneficial for a hilly land like Rwanda. No negative effects with using fodder trees were observed or commented by the farmers in the individual interviews. Probably because of the extremely improved results compared to earlier. The farmers also got the seedlings from Vi-Life and did not have to decide which trees they should use, which means that the species probably was tested and suitable for the environment.

The result of the study showed that napier grass is the main fodder used to all kind of ruminants by the farmers in the study. Probably are napier grass and other small grasses the most common fodders as well in the Northern Province as in whole Rwanda according to the interviews and the view of the landscape. Grass was the main part of the vegetation and it is easy to plant and grows in many environments. Calliandra, the fodder tree species that was mostly used have a lot of good properties and has given a great result since the farmers start using it. Calliandra seem to be planted and used as a fodder tree because Vi-life told the farmers to use it. It is probably not as common to use it as a small scale farmer not connected to Vi-life. Other protein sources from other trees and shrubs that were used seem to be used in a small amount because of lack of land.

The study showed that growing trees on radical terraces were used in the northern part of Rwanda. This was because of the hilly landscape and teamwork and support from Vi-life (Kwiringarimana, 2012 personal message; Pinsoru, 2012 personal message) maybe it is not common for other rural small scale farmers because it requires a lot of work and probably costs. The farmers in rural areas are often low educated and poor (Nilsson, 2008; Sida, 2012). Radical terracing seems to be a profitable way to grow seeds and fooder, especially for small scale farmers who have small access to land use and in a hilly land like Rwanda. To plant the fodder in hedges or great banks instead does not seem to be easy because of the slopes.

How often the trees and grasses were harvested was only answered by few farmers but the answers from the study showed that the calliandra trees was pruned approximately every third month and the grass was cut approximately every month. The literature (Kitalyi et al., 2005) has shown that the calliandra tree can be pruned every six month and still get the same amount of biomass as after twelve weeks. This means that because of the decreased digestibility during the growth period it may be a good alternative for Vi-life-s farmers to prune the trees earlier. The napier grass according to the literature (Kitalyi et al., 2005) should be cut every second or third month which means that it may be better to wait a few weeks for the farmers that said that they cut one time a month. On the other hand the farmers may not have enough napier grass to cut it with a 2-3 month interval and the trees may not grow as fast as they can prune it every month. How much the amount of harvested biomass was should been asked in the study to compare with the literature.

How much fodder the farmers gave the cows was hard to find out. Most of the farmers did not know. To answer that question it needs more interviews, but the results showed that all farmers gave napier grass as the main forage which is recommended in the literature (Kitalyi et al., 2005). And the milk yield was in average 12.6 liters but the actually yield was really fluctuating between the farms from 4 up to 21 liters. This may depend on that the cows were

in different stages of the lactation and different ability to fodder. According to the literature (Kitalyi et al., 2005), a moderate quality cow breed, weighing 350 kg and generating 11-15 liters of milk during the first part of the lactation should get 26-40 kg of fresh high quality grass (DM: 30-20 %) and 8-12 kg (DM: 50-30 %) of fresh legume leafs if no concentrate is given.

According to this study the greatest problems was to get enough fodder, especially during the dry season and it was expensive to by concentrate. This was probably the reason for that the milk production was not high enough to cover all costs for some farmers. The problem with fodder during the dry season seems to be very important. According to the literature, calliandra which was the most used fodder tree in the study is sensitive for acid soils. Leucaena which also was used have the same disadvantage. Because of the acid soils in Rwanda it may generate a lower yield of leafs than would be possible on neutral soils. To answer the question, if there is some other species that can be used by the small scale farmers in Rwanda, a literature research was done about different species used in east Africa (see page 3-5). For instance it might be a good alternative to use more of other fodder species like *S. sesban* and *Desmodium spp* because of the toleration of acid soils. The negative property with sesbania is the short lifetime. After harvested three times it has to be replanted. Although, the short life time may be compensated by the fast growth rate, replanting requires more labor. *M. scrabella* is also one of the trees that may be profitable to use because it tolerates acid soils and a high feed quality in terms of high crude protein content and yield. *F. macrophylla* also seems to be good specie because it tolerates the dry period very well. Mulberry does not seem to have good properties for agroforestry in Rwanda because of the size. The tree grows best on flat land and may concur with other trees and seeds. *T. Orientalis* may be not being profitable to use during the dry season because the specie grows in humid areas. If guatemala grass has better properties than napier grass is not found in any literature, instead it has shown the opposite that napier grass have higher quality. The yield would have been of interest to compare but no information about the yield for guatemala grass has been found. This is just a small study and of course more research must be done to see if those suggestions are relevant. Weeds may also be a factor for decreased yield, but if the farmers were disturbed by weeds was not asked. More information about how the farmers in the study plant their fodder would have been interesting to survey because the planting strategies affect the yield. Inoculation of the seeds would be one of the aspects.

No farmer in the study dried their fodder, if the fodder is dried it is possible to store and use it during the dry season when the growth of napier grass is decreased but it requires that the farmer have enough fodder during the rainy season. This was the case for some of the farmers in the study but not for everyone. To dry the fodder during the rainy season may be hard if it rains every day. During the period when the study was done it was the time when the rain period use to be but it did not rain as much as it used to do. Some of the days were really sunny and during the period, between rain and dry season, it may be possible to dry the fodder during the days when the sun is shining. But it would be necessary to have dry buildings to store the fodder. This may be a problem because it costs money to build if it not already is available. To conserve the fodder may also require knowledge about the methods.

In overall since the farmers start to collaborate with Vi-life their income seemed to be increased and they had got the opportunities to increase their production. The use of fodder trees and the increased knowledge about farming seem to be the greatest reason to success, but still many farmers need more land to provide them.

The method with recorded interviews was really good, because it was hard to understand and write in the same time. To listen and write afterwards was easier. The translation can have been misunderstood but under prevailing conditions this was the best way. The interviews with the group when they raised their hand to answer were good from a statistic point of view, but it was hard to ask more about their problems and listen to what they had to say individually. The combination with individual and group interviews in this study was good for the result. Something that affected the time schedule in the study was the dependency of Vi-life in terms of transport and translation.

Because of that all farmers in the study were connected to Vi-life, few interviews and lack of answers, the result of how the fodder production looks is not representative for all small-scale farmers in Rwanda. To make a study with more accurate statistic more interviews would have been needed and maybe some questionnaire study with farmers connected and not connected to Vi-life.

Conclusion

Probably using agroforestry is not common in general for small scale farmers in Rwanda but the small part of all farmers in Rwanda that collaborating with Vi-life, was using agroforestry trees as fodder. Napier grass was used as the main fodder and calliandra was the most common fodder tree. The greatest benefits with using agroforestry trees as fodder were the increased crop yield, milk yield and reduced erosion. No negative effects had been seen but it is still hard to get enough fodder during the dry period. Many of the farmers need more trees to satisfy the cow's need of nutrients during the whole year if no concentrate is given. M. s*cabrella* is one fodder tree which may be successful to plant. To use radical terraces is also common by the farmers that Vi-life collaborates with but is probably not common in the remaining part of Rwanda. The use of terraces seems to be one of the best constructions to use for fodder planting.

Acknowledgements

I want to thank every farmer in the study for taking their time. I also want to say thank you to Vi-life, for taking good care, guiding and supervising. A special thanks to M. Ildephonse and Theophile for translating and thanks to John and Johan for borrowing recording equipment.

Great thanks to Sida for the excellent instructive preparing course and scholarship for doing a Minor Field Study.

I also want to thank my supervisor professor Kjell Holtenius for all help and my travel and working partner Pernilla Olsson for all exchanges of ideas and a great team work.

References

Dalc, E. B. 2012. ICRAF's strategies to promote agroforestry systems. http://www.worldagroforestry.org/downloads/publications/PDFS/RP22429.pdf

Food and Agriculture Organization of the United Nations (FAO). 2010. Population composition in selected country (by year). http://faostat3.fao.org/home/index.html#VISUALIZE_BY_AREA

Globalis, Svenska FN förbundet. 2012. Statistik för Rwanda http://www.globalis.se/Laender/Rwanda/(show)/indicators

Harrison, V. 2012. Sustainable Agriculture and Silvopastoralism. http://forest.mtu.edu/pcforestry/resources/studentprojects/silvopasture.html

Iiyama, M., Athanase, M., Badege, P., Musana, B., Rurangwa, R., Tukahirwa, J., Masuki, K., Mowo, J. G. 2012. Economic Assessment of Sustainable Land Management in Rwanda. http://www.worldagroforestry.org/downloads/publications/PDFs/PO10381.PDF

Institute of Policy Analysis and Research – Rwanda (IPAR). 2009. Rwandan Agriculture Sector Situational Analysis - An IPAR sector review.

Kariuki, J. N., Gitau, G. K., Gachuiri, C. K., Tamminga, S., Muia, J. M. K. 1998. Effect of supplementing napier grass with desmodium and lucerne on DM, CP and NDF intake and weight gains in dairy heifers. Livestock Production Science 60, 81-88.

Kitalyi, A., Mwangi. D.M., Mwebaze, S. and Wambugu, C. 2005. More forage, more milk: forage production for small-scale zero grazing systems. Technical handbook No. 33 Nairobi, Kenya: Regional Land Management unit. World agroforestry centre. 112p.

Lukuyu, M., Romney, D., Ouma, R., Sones, K. 2007. Feeding dairy cattle: A manual for smallholder dairy farmers and extension workers in East Africa. SDP/KDDP, Nairobi, Kenya. 62 pp.

McDonald, P., Edwards, R. A., Greenhalgh, J. F. D., Morgan, C. A., Sinclair, L. A., Wilkinson, R. G. 2011. Grass and forage crops. In: Animal Nutrion, 481-498. Aschford Colour Press., Gosport

Nair, P.K.R. 1991. State-of-the-art of agroforestry systems. Forest Ecology and Management 45, 5-29.

Ndayambaje, J.D., Mohren, G.M.J. 2011. Fuelwood demand and supply in Rwanda and the role of agroforestry. Agroforestry systems 83, 303-320.

Niang, A. I., Styger, E., Gahamanyi, A., Ugeziw, J. 1996. Comparative growth of 15 exotic species and provenances in high-elevation acid soils of Rwanda. Nitrogen fixing trees for acid soils- a field manual , 207-214.

Nilsson, P-U. 2008. Planting the future. Vi-Agroforestry's strategy 2008-2011. xxx-printers, Nairobi.

Orwa C, Mutua A , Kindt R , Jamnadass R, Simons A. 2009. Agroforestree Database:a tree reference and selection guide version 4.0 (http://www.worldagroforestry.org/af/treedb/)

Pan African Conservation Education Project (PACE). 2012. Planting fodder banks for livestock. Action sheet 37. http://www.paceproject.net/UserFiles/File/Soils/planting%20fodder.pdf

Pye-Smith, C. 2010. Fodder for a better future: How agroforestry is helping to transform the lives of smallholder dairy farmers in East Africa. ICRAF Trees for Change no.6, Nairobi: World Agroforestry Centre.

Roose, E., Ndayizigiye, F. 1997. Agroforestry, water and soil fertility management to fight erosion in tropical mountains of Rwanda. Soil Technology 11, 109-119.

Roshetko, J. 1994. Agroforestry for the Pacific Technologies. Winrock International, FACT net. http://www.winrock.org/fnrm/factnet/factpub/ais_web/ais8.html (2012)

Sida. 2012. Lyckad utvecklingspolitik rekordminskar fattigdom i Rwanda. http://www.sida.se/Svenska/Nyhetsarkiv/2012/Februari-2012/Lyckad-utvecklingspolitik-rekordminskar-fattigdom-i-Rwanda/

Texas A&M AgriLife Research & Extension Center at Overton. 2013. Nitrogen Fixation. http://overton.tamu.edu/faculty-staff/gerald-wayne-evers/cool-season-legumes/nitrogen-fixation/

Vi-skogen, 2012. Agroforestry - så fungerar det. http://www.viskogen.se/vad-vi-gor/vart-bistandsarbete/agroforestry-sa-fungerar-det/

Yannick Glemarec, 2007. Improving agricultural extension services for sustainable land use management in Rwanda. UNDP/GEF-MSP project on land degradation in Rwanda. Ministry of Lands, Environment, Forestry, Water and Mining.

World Agroforestry Centre (ICRAF)a. 2012. Agroforestry tree database, a tree species reference and selection guide. Flemingia macrophylla. http://www.worldagroforestrycentre.org/sea/products/afdbases/af/asp/SpeciesInfo.asp?SpID=874

World Agroforestry Centre (ICRAF)b. 2012. Agroforestry tree database, a tree species reference and selection guide. Mimosa scabrella. http://www.worldagroforestrycentre.org/sea/products/afdbases/af/asp/SpeciesInfo.asp?SpID=1157

World Agroforestry Centre (ICRAF)c. 2012. Agroforestry tree database, a tree species reference and selection guide. Morus Alba. http://www.worldagroforestrycentre.org/sea/products/afdbases/af/asp/SpeciesInfo.asp?SpID=1170

World Agroforestry Centre (ICRAF)d. 2012. Agroforestry tree database, a tree species reference and selection guide. Trema orientalis. http://www.worldagroforestrycentre.org/sea/products/afdbases/af/asp/SpeciesInfo.asp?SpID=1654

World-food-programme (WFP). 2010. Rwanda: Terracing Hailed As Key Hunger Solution. http://www.wfp.org/stories/rwanda-terracing-hailed-key-hunger-solution

Non published references

KWIRINGARIMANA Teophile. 29 May 2012. Personal message. Zone-coordinator for Kaniga district. Vi-Life programme, Rwanda.

PINSORU Oscar. 25 May 2012. Personal message. Zone-coordinator for Gasabo district. Vi-Life programme, Rwanda.

Holmström Linnéa. 2012. Photography in Northern Province of Rwanda. Student at Swedish University of Agricultural Sciences (SLU), Uppsala.

Appendix I

Questions asked during the interviews

Interviews with farmers and cooperatives

How many cows do you have?

How many times a day do you milk them and how much do they milk?

Do you keep some of the milk for the household?

Do you use zero grazing?

Do you use the manure on the field?

Have your income increased?

What problems have you had since you started?

What kind of fodder do you use?

Which tree spices?

Can you explain how you plant your fodder and how often you are pruning the trees/cut the grass?

Where are the fodder grown?

How many fodder trees do you have?

How often and how much do you feed the animals?

Are you drying the fodder?

How much of the fodder comes from the trees and how much comes from grass or supplements?

Do you need to buy more fodder during the dry season?

Group interview

How many participates?

How many has cows? More than 1, 2, 3, 4 cows?

How many is using the animals for manure?

How many of you have sheeps or goats?

How many are using them for meat/milk/manure?

How many of you with livestock are using foddertrees?

How many has: lower than 20 trees(<20)? More than 20 but lower than 50 trees (20<x<50)? More than 50 but lower than 100 trees(50<x<100)? More than 100 but lower than 150 trees (100<x<150)? More than 150 but lower than 250 trees (150<x<250)? More than 250 trees (>250)? And if more than 250, how many trees?

How many are using Calliandra?

How many uses other trees or shrubs? Which spices?

Interview with zone-coordinators

How looks an average farm that is connected to Vi-Life? Can you explain how an average farm looks in Rwanda? Differents? Average of cows, Rwanda/Vi-Life?

Which breed is most usual?

What is the major reason for having cows? Milk/manure? Something else?

Appendix I

Has Vi-life sponsored farmers with cows/goats/sheep? How many? How often?

Is zero grazing the most usual system in Rwanda? Why?

Are Vi-life promoting zero grazing? Why?

How many are using fodder trees? Which species are most common?

How many trees are most usual to have? <100?

Is there someone who uses just Calliandra or other fodder trees to feed with?

Is grass the biggest part of the fodder?

How common is it to conserv the fodder? Hay/Silage? Are Vi-life promoting conservmethods?

How are the farmers growing their fodder trees and fodder grass?

Are the benches of terraces the most common place to grow them?

Are people from Vi-life recommending Calliandra? How many is recommended?

How common is it to give concentrate?

What do you think are the biggest problems for farmers concerning fodder trees in Rwanda?

I denna serie publiceras examensarbeten (motsvarande 15, 30, 45 eller 60 högskolepoäng) vid Institutionen för husdjurens utfodring och vård, Sveriges lantbruksuniversitet. Institutionens examensarbeten finns publicerade på SLUs hemsida *www.slu.se*.

In this series Degree projects (corresponding 15, 30, 45 or 60 credits) at the Department of Animal Nutrition and Management, Swedish University of Agricultural Sciences, are published. The department's degree projects are published on the SLU website *www.slu.se*.

Sveriges lantbruksuniversitet Fakulteten för veterinärmedicin och husdjursvetenskap Institutionen för husdjurens utfodring och vård Box 7024 750 07 Uppsala Tel. 018/67 10 00 Hemsida: www.slu.se/husdjur-utfodring-vard	*Swedish University of Agricultural Sciences* *Faculty of Veterinary Medicine and Animal Science* *Department of Animal Nutrition and Management* *PO Box 7024* *SE-750 07 Uppsala* *Phone +46 (0) 18 67 10 00* *Homepage: www.slu.se/animal-nutrition-management*