American Scientific Research Journal for Engineering, Technology, and Sciences (ASRJETS)
ISSN (Print) 2313-4410, ISSN (Online) 2313-4402

http://asrjetsjournal.org/

Assessment of the Role of Trees on Farmland in Soil Conservation and Household Welfare in Rwanda.

Leonidas MANIRAHO [a]*

[a]*Department of Agribusiness, Faculty of Agriculture, Rusizi International University,Rwanda.*

Email: manirahol4@gmail.com/manirahol@yahoo.fr

Abstract

The main purpose of the research undertaken to develop this work was Assessment of the role of trees on farmland in soil conservation and household welfare in Busogo sector, Musanze District,Northen of Rwanda. It used Primary data and secondary data.

Primary data were collected using questionnaire from random sample of 67 Household heads, Secondary data were collected from different sources, e.g., Ministry of Agriculture and livestock, records, books, reports and internet. The statistical package for social sciences (SPSS) and Microsoft Excel were used to analyze the farmers' views on the role of agroforestry tree species on the soil conservation and determine the contribution of agroforestry in household welfare.

Therefore the results of this study indicated that 100 % of the interviewed have the agroforestry species in their farms and know their role in soil erosion control while (67.2 %) in soil fertility improvement and the firewood productions occupy the first place with an average of 2,331,000 Rwf, followed by timber (2 000 000 Rwf) of income generated from agroforestry products in the year 2014. However shortage of land (71.6 %), lack of access to credits (59.7 %), gender inequality (48 %) and lack of capital (40 %), were noted as the major constraints in growing agroforestry species on farms. The results derived from the field will serve guide for the decision making on how agroforestry products contribute to rural household income,the study concluded that the trees on farm has many benefits and contribute significantly to household income.

Keyword: Agroforestry, soil conservation, Household welfare.

1. Introduction

Agroforestry in Rwanda is a very ancient practice, if you look at the landscape in rural regions; you remark Rwandan farmers had always practiced agroforestry at the ignorance. The problems were to know the contributions of Agroforestry to household welfare and the challenges, problems facing Agroforestry in Busogo sector as the study area. This could be achieved by investigating the farmers' views on the role of agroforestry tree species on the soil conservation and determine the contribution of agroforestry in household welfare. The results derived from the field will serve guide for the decision making on how agroforestry products contribute to rural household income and will be also useful in determination of utilization of different agroforestry species on farms. It will also reveal the information on agroforestry tree species suitable to the area.

---

* Corresponding author.
E-mail address:manirahol4@gmail.com.

2. Methodological Framework

The quantitative design was mainly used in the presentation and explanation of the result, especially the questionnaire and in this research; both primary and secondary data were used to access information
This study adopted purposive sampling procedure where a sample has been taken within a population of 6540 households by using formula of Dagnel, 2006.

$$n = \frac{z^2 \times p \times q \times N}{d^2\left(N-1\right) + z^2 \times p \times q}$$

Where:

n = Sample size

Z = Coefficient of normal distribution

P = Probability of failure

d= Margin error

P = probability of success

N = Total number of population (universe size < 10^6 individuals)

The margin error varies between 5 % and 10 %. Here we are going to use the margin error of 10 %, the confidence level of 90 %, the probability of success (p = 0.5), failure probability (q = 0.5) and the coefficient of normal distribution (z = 1.65 in student table). The total households on these selected Cells are 67 calculated by using the above formula.

$$n = \frac{(1.65)^2 * (0.5) * (0.5) * (3396)}{(0.1)^2 * (3396-1) + (1.65)^2 * (0.5) * (0.5)} = 66.74 \approx 67$$

After the determination of a sample at Sector level, a proportionate allocation sampling has used to know the number of population to interview in each Cell.

2.1. Determination of sample size at Cell level

A sample at cell level has been selected using this formula:

$n_{i=}$ $\frac{N \times n_i}{N}$

Where ni = sample size proportion to be determined

n = sample size

N = total population

3. Research design

The study used both primary and secondary data. Primary data was gathered from farmers through face-to-face interviews using multi-stage and pre-tested questionnaires. A multi-stage questionnaire was used to collect primary quantitative data in the selected households through a household survey. Secondary data was obtained from the internet, published books and journals, and records of Ministry of Agriculture in Rwanda.

4. Data processing and analysis

The statistical package for social sciences (SPSS) and Microsoft Excel were used to analyze primary data. Pearson Chi-Square Test was used to test the existence of a relationship between independent variables.

5. Results and Discussions

5.1. Rate of agroforestry adoption

It has shown that agroforestry can provide some solutions on soil utilization problems and ensure soil ecosystem stability. The Table 1 below shows that 100 % of respondents surveyed know the role of agroforestry and have been adopted agroforestry species on their own lands.

Table1: Representation of respondents based on agroforestry adoption and its role in erosion control.

Responses	Frequency	Percentage (%)
Yes	**67**	**100**
No	**0**	**0**
Total	67	100

Source: Computed by author based on agroforestry farmers,2015

Table2. Ranks of role of trees/shrubs grown with crops.

Importance of trees	**Mean Rank**
Fruits production	4.74
Farm delimitation	7.25
Fodder production	9.02
Animal shading	10.59
Soil erosion control	4.01
Soil fertility improvement	6.31
Production of stakes	9.86
Medicinal uses	10.28
Drought prevention	8.60
Fuel wood production	4.53
Construction material	5.57
Timber production	6.62
Organic manure	9.44
Environmental protection	8.19

Test Statistics

N	67
Chi-Square	343.822
Df	13
Asymp. Sig.	.000

a. Friedman Test

Source: Computed by author based on agroforestry farmers,2015

This analysis was aided through the use of a 14 points ranked scale ranging from1 very important through 6-least important and according to this scale the lower mean is the higher important attached by farmers to the role of agroforestry species grown with crops.

A non-parametric test (Friedman's Test) is used to rank the different roles of agroforestry species grown with crops in farmers 'exploitations. The most roles of agroforestry species grown with crops are various and should change any time and this lead us to reject the null hypothesis denoted that the most role of agroforestry species grown with crops is soil erosion control (Chi-squared value 343.822 p=0.000).

Table 3.Roles agroforestry trees on croplands

Roles on crop land	**Frequency**	**Percentage**
Drought prevention	23	34.3
Soil fertility improvement	41	61.1
Crop shading	30	44.7
Protection against erosion	67	100
Wind break	30	44.7

Source: Computed by author based on agroforestry farmers,2015

According to the table 5 we remarked that protection against erosion (100 %), Soil fertility improvement (61.1 %), are the major roles played by agroforestry trees / shrubs in the associated croplands.

5.2. Distribution of respondents according to the use of biomass from agroforestry species

Table4: Friedman test statistical on the use of biomass from agroforestry species.

Use of biomass	**Mean Rank**
Left scattered in the field	2.41
Ploughed into the soil after scattering	1.60
Scattering them in the soil	3.22
Transform into compost	2.77

Source: Computed by author based on agroforestry farmers,2015

The table4 above indicates the use of biomass from agroforestry species by the respondents. As shown by this table, the first the respondents prefer to plough the biomass into the soil after scattering them with the mean rank of 1.60 followed by Left the biomass scattered in the field; transform into compost and Scattering them in the soil with the mean rank of 2.41; 2.77 and 3.22 respectively.

Table 5: Friedman test statistical on the causes of soil erosion

Causes of soil erosion	**Mean Rank**
Rainfall as a cause of erosion in the farm	3.23
Deforestation as a cause of soil erosion in the farm	3.65
Inadequate farming techniques as a cause of soil erosion in the farm	4.38
Absence of erosion control measures as a cause of soil erosion in the farm	4.59
Nature of soil as a cause of soil erosion in the farm	4.01
High slope as a cause of soil erosion in the farm	4.75
The lack of natural vegetation as a cause of soil erosion in the farm	3.39

Source: Computed by author based on agroforestry farmers,2015

The above table5 shows the ranks of the variables which may contribute as the causes of soil erosion. The Friedman test gives us different levels of ranks and the smaller the mean the most is important is the variable the reason why rainfall is more important cause for soil erosion than others variables with the rank of 3.23, followed by the lack of natural vegetation; deforestation; nature of soil; inadequate farming techniques; absence of

erosion control measures and high slope with the mean ranks of 3.39; 3.65; 4.01; 4.38; 4.59 and 4.75 respectively.

5.3. *The methods used by respondents for soil erosion control and conservation*

Table6: Friedman test statistical on the method for erosion control and soil conservation

method used for soil erosion control and soil conservation	**Mean Rank**
Digging trenches	3.46
Water channel	4.97
Bench terraces	5.07
Mulching	5.18
Agroforestry trees species plantation	1.94
Hedge	5.13
Progressive terraces	2.25

Source: Computed by author based on agroforestry farmers,2015

The table above indicates the different methods used for soil erosion control and soil conservation by the respondents. As shown by this table 6, the first method used in soil erosion control and soil conservation is Agroforestry tree species plantation in the study area with the mean rank of 1.95 while others methods used are Progressive terraces; Digging trenches; Water channel; Hedge; Mulching and Bench terraces with the mean ranks 2.25, 3.45, 4.97, 5.13, 5.18 and 5.07 respectively.

5.4. Agroforestry for soil conservation

Table7: Plantation of trees in the cropland for protection

Roles on the environment	Frequency	Percentage
Soil erosion control	55	82.1
Wind break	30	44.8
Rain fall interception	17	25.4
Biodiversity maintenance	20	29.9
Drought prevention	23	34.3
Soil fertility improvement	41	61.1
Crop shading	30	44.7
Protection against erosion	67	100

Source: Computed by author based on agroforestry farmers,2015

The table 7 above shows the roles of trees in the cropland where soil erosion control represent 82.1%, wind break(44.8%), rain fall interception(25.4%) ,biodiversity maintenance(29.9%) ,draught prevention (34.3%), soil fertility improvement (61.1%), crop shading(44.7%), and protection against erosion (100%).

5.5. Agroforestry species in household welfare

5.5.1 Distribution of respondents according to different trees products harvested

The following table shows the results of different trees products harvested in respondents ‘farms.

Table 8: Agroforestry products harvested according to respondents

Products	Frequency	Percentage
Fire wood	57	100
Stakes	7	12.2
Charcoal	3	5.2
Fodder	45	78.9
Building poles	37	64.9
Fruits	51	89.4

Source: Computed by author based on agroforestry farmers,2015

From the results of the above table 8, it is clear that many respondents harvested firewood as main product (89.5 %), followed by building poles (62.6 %), fruits (37.3 %) and timber (22.3 %). Then products from stakes (5.9 %), fodder (7.4 %) and medicinal products were harvested with few farmers.

5.6. *Estimated expenses from agroforestry products during the year 2015*

The following table 9 shows the expenses from different trees products during the year 2015 according to respondents**.**

Table9: Estimated expenses from trees products during the year 2015

Type of expenses	Quantity	Unity price (Rwf)	Total price (Rwf)
Axes	20	2 000	40 000
Sacs	300	250	750 000
Low barrow	6	25 000	75 000
Pangas	67	1 000	67 000
Labours	2000	800	1 600 000
Unplannified (10 %)			260700
Total			**2 867 700**

Source: Computed by author based on agroforestry farmers,2015

The results of table 9 show the expenses of respondents from agroforestry products management and harvest; such include money expenses for buying axes, sacs, low barrow, pangas, labours and others.

5.7. *Income got from different uses of tree products.*

The following table 10 illustrates the results from income generated by trees products harvested by respondents in their farms during the year 2015.

Table10: Estimated income generated by trees products during the year 2012

Type of products	Unit	Quantity / year	Unity price (Rwf)	Total selling price (Rwf)
Firewood	St	8	4500	2 331 000
Stakes	Burden	50	500	25 000
Charcoal	Bag	84	5000	420 000
Fodder	Bundle	1800	300	540 000
Building poles	Poles	720	800	576 000
Fruits	Kg	5400	150	810 000
Timber	Number	2000	1000	2 000 000
Total				6 702 000

Source: Computed by author based on agroforestry farmers,2015

Benefit= Income - Expenses

Income: 6 702 000 RWF
Expenses: 2 867 700RWF
Benefits: 6702 000 RWF – 2 867 700 RWF = 3 834 00 RWF

The results of table 23 show the income generated by agroforestry products during the year 2015. We remark that the main products generated high incomes in that year are as following: firewood, timber, fruits, building poles, fodder, charcoal and stakes.

5.8. Use of income from trees products

The utilization of income from agroforestry trees / shrubs should be used in different ways in which we may include self-consumption, school fees, agricultural investment, health care and others.

Table11: Agroforestry species in household economy

Uses	**Frequency**	**Percentage**
Self-consumption	52	77.6
School fees	15	22.4
Agriculture investment	10	14.9
Health care	51	76.1
Breeding	12	17.9
Buildings	4	6

Source: Computed by author based on agroforestry farmers,2015

From results of this Table 11, the income from tree products is mainly used for self-consumption (77.6 %), health care (76.1 %), school fees (22.4 %), breeding (17.9%), agriculture investment (14.9 %) and buildings (6 %).

5.9. ***Constraints face in growing agroforestry species***

The major constraints face in growing trees consist of two sorts: constraints related to agronomic factors and those of social-economic and organizational factors. The following figure gives more detailed information about these constraints.

Table12: Constraints faced in growing agroforestry trees/shrubs

Constraints	Percentage
Lack of seedlings	22
Shortage of land	71.6
Lack of capital	40
Insufficient skills of farmers	19
Lack of technical advice	25
Gender inequality	48
Lack of access to credits	59.7

Source: Computed by author based on agroforestry farmers,2015

From the results of Table 12, we remark that shortage of land (71.6 %). Lack of access to credits (59.7 %), gender inequality (48 %), have been cited as the main constraints face in growing agroforestry species in the study area. The lack of capital (40 %), lack of technical advice (25 %), lack of seedlings (22 %), and insufficient skills (19 %) have been shown as secondary constraints.

6.Conclusion and Recommendations

The trees of farm appreciate the contribution of agroforestry species on the soil conservation and household welfare by providing many products (firewood, fruits, construction materials,Timber, charcoal etc) and services including erosion control in croplands, crop shading, land delimitation, drought prevention, good air for respiration etc. where is concluded 100 % by findings

Therefore the results of this study show that 100 % of the interviewed have the agroforestry species in their farms and know their role in soil erosion control while (67.2 %) in soil fertility improvement. The results show that the firewood productions occupy the first place with an average of 2,331,000 Rwf, followed by timber (2 000 000 Rwf) of income generated from agroforestry products in the year 2014. However shortage of land (71.6 %), lack of access to credits (59.7 %), gender inequality (48 %) and lack of capital (40 %), were noted as the major constraints in growing agroforestry species on farms.

The research took place in Busogo Sector in Musanze District with a purpose of assessing the roles of farmland trees in soil conservation and household welfare.

The results of this study were permitted to assess the farmers' views on the role of agroforestry tree species on the soil conservation and determine the contribution of agroforestry in household welfare.

In fact the trees of farm appreciate the contribution of agroforestry species on the soil conservation and household welfare by providing many products (firewood, fruits, construction materials, charcoal etc) and services including erosion control in croplands, crop shading, land delimitation, drought prevention, good air for respiration etc.

However, many problems face in growing agroforestry trees/shrubs were found in this region from which the crucial listed from them are land scarcity, lack of planting material (seedlings / seeds), lack of capital, low level of farmers' instruction, lack of sufficient technical advice, gender inequality in decision making and lack of access to credits.

Beside these, some suggestions were proposed by respondents for sustainable agroforestry at Busogo Sector in which we may found nursery establishment at cell level, establishment of demonstration fields, training on agroforestry practices, access to financial credits, access to inputs credits, improve and include gender in decision making and accessibility to seminars.

This study is of high importance for rising up the household welfare and preserving the environment. We welcome different levels concerned especially government, NGOs, From the highlighted problems found out when analyzing and discussing the results of the study here above, the following recommendations and suggestions were formulated:

- On local authority of Busogo Sector, ensure efficient control against deforestation/cutting – off immature trees,
- On NGOs and agriculture development projects provide and improve extension services and facilitate the availability of seeds/seedlings preferred by farmers;
- On farmers, cultivate in their exploitations species which prevent soil erosion and provide main products and services for increasing household welfare and environment preservation;
- Production of agroforestry trees/shrubs preferred by farmers as for example grafted fruits trees for increasing household income and willingness in agroforestry adoption;
- Including all stakeholders in decision making in order to produce desirable seedlings and in sufficient quantity;

REFERENCES

1. Arnold, J. and Kalinganire .*Tree management in farmer's strategies: responses to Agricultural intensification.* Oxford university press, UK,1995, pp.48.

2. EGRI, karinganire, A.,The Agroforestry and shrubs in Rwanda, ISAR, Butare, Rwanda.1988,pp.31-40.
3. Franzel,S.and Scherr, S.J.*Trees on farm; assessing the adoption potential of Agroforestry Practices in Africa*, ICRAF, 2002,pp. 37-67.

4. Hategekimana J.P and Ntirenganya J.B (2010), soil conservation and management the adoption of bench terraces for sustainable soil conservation in terraces for sustainable soil conservation in Gakenke District, Gakenke sector.
5. Hil kuypers (2002):*Erosion control in the tropics*, AGROMISA P.O BOX 41,6700 AA
6. Hudson, NW,(1991): *Soil conservation Beats Ford*, London,:320p. Kenya.
7. Lwakuka, A *et al*., (2003): *Agroforestry hand book for the mountain zone of UGANDA*,
8. Mukurarinda *et al* (1997) : *Situation of Agroforestry in Rwanda after 1994*. Survey of April to May 1997, ISAR/ICRAF, Butare.
9. MINAGRI, 2015.Annual report.
10. NAIR, P.K.R. (1985): *Classification of Agroforestry systems*. In Working paper no 28. ICRAF, Nairobi, Kenya.
11. Rayar, A. J. (2000). *Sustainable agriculture in sub-Saharan Africa. The role of soil productivity*, AJR Publications, Chennai, India. pp.193.
12. Ruskin, D. (1992). *The use and value of multiple methods to capture the diversity of indigenous agroforesty knowledge*. 30pp.
13. Schimer, J. (2002). *Farm forestry and agroforestry research*. 34pp.