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Agroforestry And Soil- Water Conservation In Kamwenge District,Western Uganda: A Case Study Of Kahunge Town Council

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Abstract*: In this era of global warming, fast degradation of land productivity and other environmental hazards, agroforestry is indeed a stake for natural resources and socio-economic sustainability. Agroforestry is found to be the most desirable strategy for maintaining social, economic and ecological sustainability in Uganda. Therefore, a study was undertaken to investigate the extent of agroforestry and the socio-economic development of the Farmers of Kahunge Town council in Kamwenge district, the level of agroforestry in the area of study, the adoption level of agroforestry practices and the socio-economic and ecological impact of agroforestry on the farmers. The target population for the study was 2500 agro forestry farmers who practiced agro forestry as they were considered as having relevant data for the study. The researcher considered a sample size of 345 respondents and this was determined using Israel Glenn (2012) formulan. The findings revealed that farmers. From the findings majority of the respondents 160(46.37) planted Guriveria in their agricultural fields, 156(45.2%) planted calliandra, 19(5.50%) planted Napier/staria and lastly 10(2.89%) planted bamboo in their land. 212 (61.44%) of the respondents stated that agroforestry fix nitrogen in the soil and 50 (14.49%) said that agroforestry offer anchorage to the soil preventing it from erosion, 43(12.46%) explained that it results to high soil fertility and 40(11.59%) said that it maintains soil moisture that is good for soil microbial activities. 200 (59.7%) of the respondents who strongly agreed that agroforestry fixes nitrogen in the soil.100(28.98%) agreed that it fixes nitrogen in the soil and 45(13.04%)were undecided.250(72.46%) of the respondents revealed that agroforestry offers anchorage to the soil,50(14.45%) of the respondents agreed that it supports the soil and 45(13.04%) of the respondents were undecided.260(75.3%) of the respondents said that agroforestry maintains the soil moisture,40(11.5%) of the respondents also agreed and other 45(13.04%) were undecided. 300(86.9%) of the respondents strongly agreed that agroforestry results to high soil fertility, 40(11.5%) of the respondents agreed and 5(1.11%) were undecided. The Study used a cross sectional survey and a sample size of 345 respondents from the selected villages in Kahunge Town council in Kamwenge district who were selected both randomly and purposively. The researcher recommends that policy makers should implement their national and district plans. There is a need to have bylaws at community level to enable every farmer to plant agroforestry seedlings in his land. There should be extensive agricultural advisory services at community level.*

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CHAPTER ONE:

GENERAL INTRODUCTION

1.0 Introduction

This chapter presents the background to the study, statement of the problem, objectives of the study, research questions, scope of the study, significance of the study and the definition of operational terms.

1.1 Background to the study

Agro forestry practice is increasingly recognized as a useful and promising approach to soil conservation that combines goals of sustainable agricultural development for resource-poor tropical farmers with greater environmental benefits than less diversified agricultural systems, pastures, or monoculture plantations (Forman, 2015). Among these expected benefits is the conservation of a greater part of the native biodiversity in human-dominated landscapes that retain substantial and diversified tree cover. Although the protection of natural habitat remains the backbone of biodiversity conservation strategies, promoting agro forestry on agricultural and other deforested land could play an important supporting role, especially in mosaic landscapes where natural habitat has been highly fragmented and forms extensive boundaries with agricultural areas.

Agro forestry as a land use system is receiving greater attention in many countries to protect the land from various types of degradation. Agro forestry practice offer considerable benefits for the long term agricultural sustainability (ICRAF, 2014), it is a tool for achieving sustainable agricultural farming and improving the quality of life of the affected communities while simultaneously reversing the process of environmental as well as land degradation (UNCCD, 2013). It is a dynamic ecologically based natural resources management system (Young, 2009).

An agro forestry approach is one of the best management practices of natural resources (Mohan, 2009) which can be foundations for improving economic growth as well as environmental protection. Agro forestry practices has also the potential to increase the production of food, fuel wood, building materials and fodder while arresting soil erosion and fertility decline that is why it is an integrated approach that satisfies all the needs of farmers (Abdu, 2014).
In Africa, agro forestry systems, capable of providing substantial net economic and ecological benefits to households and communities, should be readily adopted by farmers. Despite this, many attempts to promote agro forestry have resulted in poor rates of adoption (Zinkhan & Wear, 2012). According to studies done by Current, Lutz &Scherr (2015), there are higher net present values for agro forestry systems when compared to monoculture systems, yet farmers in developing countries show low rates of adoption. For many years, farmers in Africa have been testing improved agro forestry including Kenya, Zambia, Cameroon, Tanzania, and Malawi in collaboration with researchers at International Council of Research in Agro-forestry and National Agricultural Research Systems (NARS) as important for crop improvement and increased yields for commercialization (Kwesiga & Coe, 2014). Furthermore, the adoption of agro forestrypractices in Sub-Saharan countries has increased per capital income which is derived from timbers, papers and increased exports of crops (Kwesiga & Coe, 2014).

A study conducted in over 700 households in East Africa found that at least 50% of those households had begun planting trees ten years ago on their farms such as calliandra, species, apples, avocado trees to diversify their productivity (Mercer, 2014). Agro forestry practices combines agriculture and forestry to generate integrated and sustainable land-use systems. Agro forestry practices take advantage of the interactive benefits from combining trees and shrubs with crops and/or livestock production. The trees ameliorate the effects of climate change by helping to stabilize erosion, improving water and soil quality and providing yields of fruit, tea, coffee, oil, fodder and medicinal products in addition to their usual harvest that are sold to the market and contributes to increased incomes thus leading to social economic development (Mercer, 2014).

In Busia County in Kenya, Wood fuel Development Programme revealed that agro forestry is a traditional practice that has existed in the area for many years. Further, most of the inhabitants of these areas practice three major agro forestry systems namely, agrosilvicultural, silvipastoral and agrosilviculture which helped in controlling soil erosion thus increases crop yields for commercialization that increases incomes contributing to reduced poverty and enhances social economic development (Bradley, 2013).

In Uganda, several initiatives have been put in place in rural areas to conserve soil and organic matter and boost farmers' per capita income which is an important indicator of economic development. Among other initiatives, agro forestry practice continues to be implemented in many districts of Uganda under the banner of improving farmers' livelihood and improving economic development (Smith, 2015). For instance, in the Southwestern Uganda, agro forestry practices have been adopted through the VI agro forestry

program, a Swedish government-funded project through Swedish Development Cooperation Agency (SIDA) to help in soil and water conservation.

In the study area, (Kahunge Town Council) practically there are no farming practices where one or more tree species are not integrated. Weedy plant species play a vital role in nutrient recycling thus they increase agricultural output for commercial purposes leading to improved economic development. The perennial crops protect the soil from erosive forces and induce the rain water to seep slowly into the soils. The soil management practice in the study area is predominantly of indigenous farming system such as crop rotation, terracing and mulching or traditional agro forestry with application of conservation tillage system. Although agro forestry practice is not an entirely new practice in Uganda, there is limited information about how this practice affects soil and water conservation. It is against this background that this study will be conducted to fill the gap by establishing the effect of agro forestry practices on soil and water conservation in Kamwenge District with reference to Kahunge Town Council.

1.2 Statement of the problem

The problem seeks to establish whether there has been need for agro forestry in soil-water conservation in Kamwenge District with reference to Kahunge Town council.
Although there are agroforestry trees in Kahunge subcounty in Kamwengye district,the few planted trees have not protected the soil from being eroded by the runoff and this has lowered down the nutrient levels that has also reduced crop productivity.50% of Kahungye subcounty is degredaded.

1.3 Objectives of the study

1.3.1 General objective

To establish how agro forestry affect soil and water conservation in Kahunge Town council, Kamwenge District.

1.3.2 Specific objectives.

1.3.2.1 To establish the level of agro forestry in Kahunge Town Council, Kamwenge District.
1.3.2.2 To establish the extent of soil–water conservation in Kahunge Town Council, Kamwenge District.
1.3.2.3 To assess the contribution of agro forestry practices towards improvement of livelihood in Kahunge Town Council, Kamwenge District.
1.3.2.4 To assess whether there is a relationship between agro forestry and soil-water conservation.

1.4 Research questions

1.4.1 What is the level of agro forestry practice in Kahunge Town council, Kamwenge District?
1.4.2 What is the extent of soil-water conservation in Kahunge Town council, Kamwenge District?
1.4.3 What is the contribution of agro forestrypracticestowards improvement of livelihood in Kahunge Town Council, Kamwenge District?
1.4.4 What is the relationship between agro forestry and soil-water conservation in Kahunge town council, Kamwenge district?

SECTION TWO

RESEARCH METHODOLOGY

2.0 Introduction

This chapter presents the methodology that was employed to ease the success of this study. It includes research design which describes the nature and pattern designed and the procedures used for its accomplishment, population of the study; the sample size, sampling techniques, sources of data, data collection methods, data collection instruments, data collection procedure, data analysis, ethical considerations and limitation of the study.

2.1 Research Design

The study adopted a descriptive and experimental research design which attempted to answer a research question that asks what effects one variable has on another variable. It will also describe situations and events such that, an observer observes an event or a

situation and tries to describe it as best as he/she can according to how things unfold. The study will involve both qualitative and quantitative approaches during data collection. Qualitative approach will enable the researcher to give a complete, detailed description of phenomenon while quantitative approach will enable the researcher to construct statistical models in an attempt to explain the findings. Quantitative approach will provide comparisons and statistical aggregation of data.

2.2 Area of study

The study was conducted in Kahunge Town Council, Kamwenge District. The Town Council is sub county to the west and to the north to the East and it is endowed with natural resources mainly streams and swamps. The major crops that are grown in the area are Irish potatoes; bananas, cassava, sweat potatoes, beans, cabbages and sorghum. The area is characterized by both loam and volcanic soils considered suitable for crop growing. Some of the areas in the sub county are rugged with steep slopes which force some farmers to practice agro forestry to prevent soil erosion .For example rugged steep slopes of Rubaba hill. Some areas are on high altitude while others on low altitude.

2.3 Study Population

The target population for the study was 2500 agro forestry farmers who practiced agro forestry as they were considered as having relevant data for the study.

2.4 Sample Size

The researcher considered a sample size of 345 respondents and this was determined using Israel Glenn (2012) formulan=$\frac{N}{1+Ne^2}$ where n is the sample size, N is the study population while e^2 is the level of precision which is 0.05

n=$\frac{2500}{1+2500(0.05^2)}$ = n=$\frac{2500}{1+2500(0.0025)}$n=$\frac{2500}{7.25}$ = 345

2.5 Sampling Techniques

The researcher employed various sampling techniques that included the following;

2.5.1 Simple Random Sampling

This method involved giving all the members in the target population an equal chance of being selected to participate in the study. The researcher seek for assistance from the local administration and the village heads. A list of household heads was requested from the village heads. Respondents were chosen randomly from the list and the name of the household heads chosen were marked until the entire sample required was exhausted. Through the simple random sampling, a sample of 345 respondents were picked.

2.6 Types of Data Collected and Source

The study used primary data to determine the relationship between the variables. Primary data are the data observed or collected directly from first-hand experience. In this study primary data was collected using a questionnaire and interviews.

2.7 Data Collection Methods

2.7.1 Questionnaire method

The current study used questionnaire method in collecting data. The researcher used this method to collect data because it is convenient as respondents fill questionnaires during their free time and have a chance to consult for views and information about the research problem. This method will produce a more focused and relevant data for the study.

2.7.2 Key Informant Interviews

In the context of this study, interviews were used as informal conversations that allowed the researcher to extract rich and detailed information from interviewee (s). In so doing, the researchers first prepared a guide list to remember what they wanted to raise during interview. This method was quite important whereby the well informed respondents being interviewed provided the researcher with rich and detailed information on the subject of inquiry. For this very purpose the researcher interviewed local leaders who were purposively selected.

2.7.3 Direct Observation

This was an important technique for the study and it involved careful watching and recording of whatever the researcher was interested in for the purpose of answering the main research question. In this approach, the researcher maintained presence in the

study area and visited various villages. During these visits, he observed what was on the farms (crops grown on the farms), agro forestry systems, types of trees grown, location of the trees and in general, how land was utilized. The method was important since it was used to verify some of the information that had been collected during the questionnaire survey and it also generated detailed qualitative data.

3.8 Research instruments

2.8.1 Interview Guide

The interview guideline contained key elements that were explained by the researcher to the respondents in different words. These questions were used to interview respondents who gave their views and opinions about the problem under study.

2.8.2 Observation Guideline

The observation guideline contained a list of elements to be observed. This list contained for example words like cars, roads and accidents.

2.8.3 Documentary Review

The researcher used a variety of documentary sources including books from libraries. Internet also played a big role in obtaining necessary information. Relevant literatures from existing empirical studies and reports on floods management and the socio-economic development were reviewed.

2.9 Experimental Design Procedure

Onsite

The researcher used the following procedure for soil sampling;

To select the area to be sampled

Samples were not picked from under trees, near fences, manure, heaps, foot paths and anthills.

Clear off the vegetation from the site were done.

A slice of soil was taken to a depth of about 15cm from each of the sites.

Samples were mixed from various sites thoroughly to get a composite sample.

Laboratory work

Composite samples were dried.

A small sample from the composite taken, labeled and taken to the laboratory for study.

The researcher made sure that he uses clean equipment and a sample would not be taken from an area beyond 5 hectares.

The label included name data and the place where it was taken from.

Depth of sampling, tools and methods used were noted.

The purpose for which the sample is taken was also noted.

3.10 Data Collection Procedure

After successfully finishing compilation of a research proposal, the researcher proceeded to the field for data collection. However, he had to first obtain an introductory letter from the Head of Department of Education and Humanities that introduced him to the authorities where the study was conducted from. After being permitted by the authorities, the researcher went ahead to identify respondents who participated in the study. Consent from respondents was sought and this was in form of written document that accompanied the questionnaires. Data collection was done in a period of two weeks. After then data was organized, coded and put in computer for analysis.

3.11 Methods of sampling

Random sampling method where the researcher picked 6 soil samples from agro forested area and 6 samples from non-agro forested area.

Test Procedure:

According to Krishna, (2011), the test procedure for organic matter is as follows;

(1) Determining and recording the mass of an empty, clean, and dry porcelain dish (M_P).

(2) Placing a part of or the entire oven-dried test specimen from the moisture content experiment in the porcelain dish and determine and record the mass of the dish and soil specimen (M_{PDS}).

(3) Placing the dish in a muffle furnace. Gradually increase the temperature in the furnace to 440^0C. Leave the specimen in the furnace overnight.

(4) Removing carefully the porcelain dish using the tongs (the dish is very hot), and allow it to cool to room temperature. Determining and recording the mass of the dish containing the ash (burned soil) (M_{PA}).

(5) Emptying the dish and clean it.

Measurements

Determination of the mass of the dry soil ($M_D=M_{PDS}-M_P$)

Determination of the mass of the ashed (burned) soil ($M_A=M_{PA}-M_P$)

Determination of the mass of organic matter ($M_O = M_D – M_A$)

Determination of the organic matter (content) ($OM = (M_O/M_D)*100$)

The experiment will compare the organic matter content of agro forested and non-agro forested soils.

3.12 Data Analysis

The data was coded, categorized and analyzed using computer software packages MS Excel (2010). Quantitative data was analyzed by simple Microsoft excel which generated frequency tables, charts and graphs to present the findings. Qualitative data generated from the interviews was analyzed through careful interpretation of meanings and contents and ordering and ranking with descriptive manner. The presentation of data was done using tables, bar graphs and pie charts that were drawn using micro soft excel program.

3.12 Ethical Considerations

Approvals were sought from relevant authorities before proceeding with the research study in an effort to have oversight and protect the participants.

The respondents were assured of confidentiality of the information that will be provided and the respondents will be informed that the study findings will be used for academic purposes only.

The researcher strived to make the selection of the population to study and the specific subjects to study fair, and, therefore, the risks and benefits to be fairly distributed.
Subjects will be selected for reasons directly related to the problem being studied. Only subjects from households in the study area will be enrolled in the study.

CHAPTER THREE

DATA PRESENTATION, ANALYSIS AND INTERPRETATION

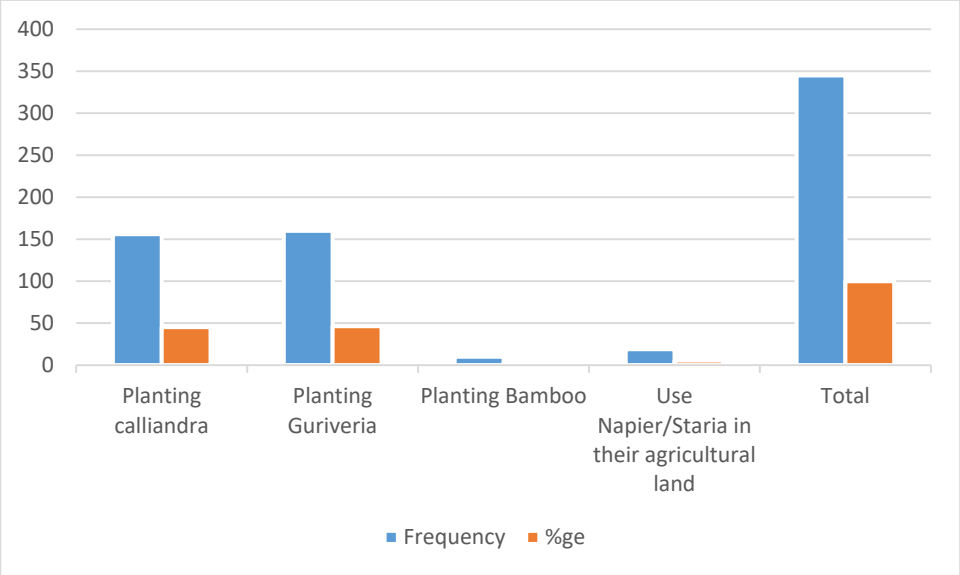
3.1 Empirical Findings

3.3.1 Description of objective on the extent of agroforestry practices in Kamwenge district

The researcher investigated the extent of agroforestry extent and got the following results:

Agroforestry practices	Extent	Frequency	%ge
Planting calliandra	Moderate	156	45.2
Planting Guriveria	Large	160	46.37
Planting Bamboo	small	10	2.89
Use Napier/Staria in their agricultural land	large	19	5.50
Total		345	100

From the above table, majority of the respondents 160(46.37) planted Guriveria in their agricultural fields, 156(45.2%) planted calliandra, 19(5.50%) planted Napier/staria and lastly 10(2.89%) planted bamboo in their land.



3.3.2 Description of objective two on the contribution of agroforestry practices on soil and water conservation.

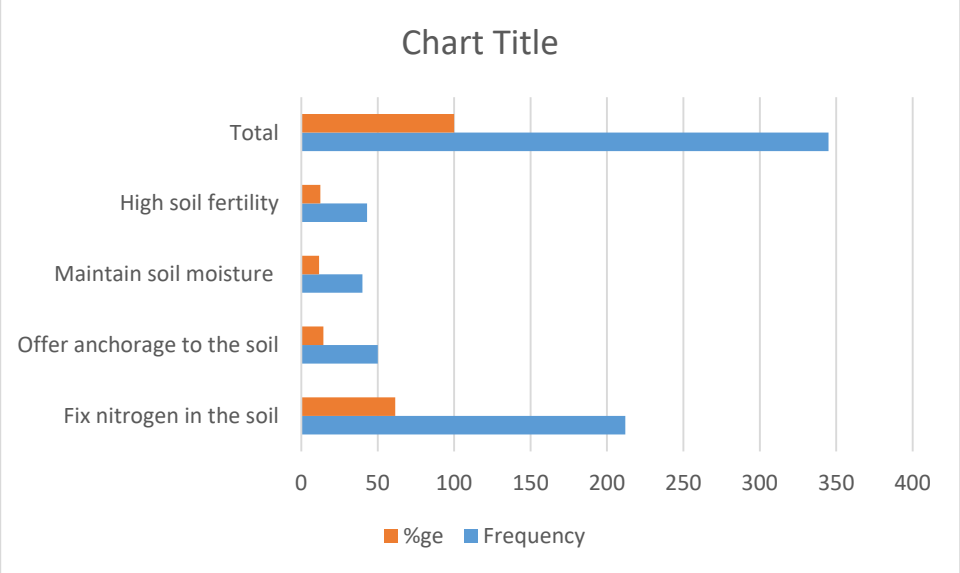
Table 3.3.2: Contribution of agroforestry practices on soil and water conservation

Statement	Frequency	% ge
Fix nitrogen in the soil	212	61.44
Offer anchorage to the soil	50	14.49
Maintain soil moisture	40	11.59
High soil fertility	43	12.46
Total	**345**	**100**

Source: Primary Data, 2019

From table 4.7 212 (61.44%) of the respondents stated that agroforestry fix nitrogen in the soil and 50 (14.49%) said that agroforestry offer anchorage to the soil preventing it from erosion, 43(12.46%) explained that it results to high soil fertility and 40(11.59%) said that it maintains soil moisture that is good for soil microbial activities.

The above data has also been presented by the use of a line graph.



3.3.3 Relationship between Agroforestry practices and soil and water conservation

The table below shows the findings on the relationship between Agroforestry practices and soil and water conservation.

Table 3.3.3: Relationship between Information technology and payroll management

Statement	Strongly agree	Agree	Undecided	Strongly Disagree	Disagree	Total

	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq (%)
Agroforestry fix nitrogen in the soil	200	57.97	100	28.98	45	13.04	0	0	0	0	345 (100%)
Agroforestry offer anchorage to the soil	250	72.46	50	14.49	45	13.04	0	0	0	0	345 (100%)
Agroforestry maintains soil moisture	260	75.3	40	11.5	45	13.04	0	0	0	0	345 (100%)
Agroforestry results to high soil fertility	300	86.9	40	11.5	5	1.44	0	0	0	0	345 (100%)

Source: Primary Data, 2019

From the above table agroforestry has different roles it plays as indicated by 200 (59.7%) of the respondents who strongly agreed that agroforestry fixes nitrogen in the soil.100(28.98%) agreed that it fixes nitrogen in the soil and 45(13.04%)were undecided.250(72.46%) of the respondents revealed that agroforestry offers anchorage to the soil,50(14.45%) of the respondents agreed that it supports the soil and 45(13.04%) of the respondents were undecided.260(75.3%) of the respondents said that agroforestry maintains the soil moisture,40(11.5%) of the respondents also agreed and other 45(13.04%) were undecided.
300(86.9%) of the respondents strongly agreed that agroforestry results to high soil fertility, 40(11.5%) of the respondents agreed and 5(1.11%) were undecided.

SECTION FOUR

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

4.1 Introduction

This chapter presents the summary, conclusions, and recommendations of the study. They are based on the findings in the previous chapters and the study objectives which relied heavily on the study questions.

4.2 Summary of Findings

From the findings majority of the respondents 160(46.37) planted Guriveria in their agricultural fields, 156(45.2%) planted calliandra, 19(5.50%) planted Napier/staria and lastly 10(2.89%) planted bamboo in their land. 212 (61.44%) of the respondents stated that agroforestry fix nitrogen in the soil and 50 (14.49%) said that agroforestry offer anchorage to the soil preventing it from erosion, 43(12.46%) explained that it results to high soil fertility and 40(11.59%) said that it maintains soil moisture that is good for soil microbial activities. 200 (59.7%) of the respondents who strongly agreed that agroforestry fixes nitrogen in the soil.100(28.98%) agreed that it fixes nitrogen in the soil and 45(13.04%)were undecided.250(72.46%) of the respondents revealed that agroforestry offers anchorage to the soil,50(14.45%) of the respondents agreed that it supports the soil and 45(13.04%) of the respondents were undecided.260(75.3%) of the respondents said that agroforestry maintains the soil moisture,40(11.5%) of the respondents also agreed and other 45(13.04%) were undecided.
300(86.9%) of the respondents strongly agreed that agroforestry results to high soil fertility, 40(11.5%) of the respondents agreed and 5(1.11%) were undecided.

4.3 Recommendations

The researcher recommends that policy makers should implement their national and district plans

There is a need to have bylaws at community level to enable every farmer to plant agroforestry seedlings in his land.

There should be extensive agricultural advisory services at community level

4.4 Recommendation for further study

This study calls for further research on the use of bamboo, determining the species that works best in the some selected areas in Kahunge Village in Kamwenge district.

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