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An Assessment Of The Learners' Awareness Of The Role Of Trees In The Conservation Of Water-Shed Quality: A Case Study Of Manafwa River Watershed In Bududa District In Uganda

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Abstract

Manafwa valley is a Sub catchment of Kyoga Water Management Zone, one of the four Water Management Zones of Uganda. It is the main source of fresh water for the densely populated city of Mbale and other towns within the watershed. It is a large watershed accommodating a large section of the people of eastern Uganda. In general, the conservation and management of water-shed quality in the Manafwa valley has become a problem. It, therefore, among others has to be conserved using various approaches like tree planting, good farming practices and protecting Mt Elgon National Park. It was upon this background that, this study was designed to investigate the learners' awareness of the role of trees in conservation and management of Manafwa Valley Water-Shed quality. It tried to find out, among others, if learners were aware of the role of trees in removing and storing carbon dioxide from the atmosphere protecting the soils, attracting rains and moderating the atmospheric temperatures. Questionnaires were used as a major tool for data collection. The data was analysed using Scientific Package for Social Research (SPSS) and the results presented through percentages and descriptive statistics. The results showed that, majority of the respondents were aware of the role of trees such as acting as a remover of carbon from the atmosphere attracting rainfall, protecting the soil from both wind and water erosions in addition to regulating environmental temperatures. In general, the study concluded that learners could be involved in conservation and management of Manafwa watershed through the planting of trees.

Key words:Water-Shed Quality, Trees, Bududa

Introduction

Climate change has adverse effect on the watershed quality as surface flow triggers contamination of the water quality. The effects of climate change in Uganda are manifested by severe and sometimes extreme weather events such as droughts and landslides (Barakagira and Ndungo 2023). Increased rains can bring about siltation, landslides and floating organic materials. Nakileza and Nadala (2020) reported that, most of the slope failures existed in areas that that are between mid to upper slope positions. That, some surface flow depositions of large slides ended in streams thus undermining water quality. In another study, as the water flows, it often picks up pollutants, which may have sinister effects on the ecology of the watershed and, ultimately, on the reservoir, bay, or ocean where it ends up.

https://oceanservice.noaa.gov/facts/watershed.html#collapse-usa. Laura and Devin (2021) observed that, water is a major source of loss for most people, ranging from crop loss to contaminated water. Watershed ecosystems are also under pressure emanating from rapid urbanization, intensification of agriculture, and industrial expansion, which exacerbates soil erosion, water scarcity, and loss of biodiversity. Watershed quality management has therefore been crucial especially in the Manafwa valley on the slopes of Mt. Elgon in Eastern Uganda. This has mainly been done through integrated management practices which include tree planting.

Valatin et al (2021) noted that planting trees has become an effective step towards water-related ecosystem service. That the above practice can enhance watershed services such as nutrient retention, erosion control, stream flow regulation, protection against extreme events such as surface flow, landslides, and lead to a permanent change in land use, replacing agricultural activities that give rise to diffuse pollution. However, the effectiveness of these interventions can depend on species selection, planting configuration, and sustainable management practices. This study therefore investigated if in Bududa district, Children in Secondary schools are aware of the roles of trees in conservation and management of water- shed quality in Manafwa valley. The main objective was to establish if the learners have some knowledge on conservation and management of water-shed through planting of trees. The specific objective examined the levels of learner awareness about the roles of trees in water-shed quality conservation. Some of the

roles investigated included whether trees can remove carbon dioxide from the atmosphere, protect the soils, attract rainfall and moderate atmospheric temperatures.

Materials and Methods

This section of the study comprises of the study area and the tools that were used for the collection of data.

Study Area

This study was conducted in Bududa Comprehensive Secondary School in Bududa district. This is because it is one of the Schools in Bududa district with a large piece of land which is very close to Manafwa river valley. Bududa district lies between latitudes 1.12˚ North to 0.96˚ south and longitudes1.134.26˚ West to 34.54˚ East along on the south- west slopes of Mountain Elgon. The distance ranging from south to north is 14.9 km, and west to east is 29.6 km. The rainfall regime of Bududa is up to 1500 mm per year. The area has two peaks with two distinct dry spells, one in July and the other starting from December to around February. The district experiences a prolonged long-wet season around March to June and a short-wet season from August to November, with the highest rainfall received in May. The rainfall pattern varies with altitude. That is areas with high altitude receive high rainfall compared to low lying areas. The district's altitude ranges from 1250 to 2850 m, rising in the east to 3000 and 4000 m at the peak of Mountain Elgon. The district has generally steep slopes above 40 degrees with V-shaped valleys.

Data Collection

In this section, there is selection of the sample size, tools for data collection and processing of the information collected.

Sample Size

Bududa Comprehensive Secondary School was purposively selected because they were willing to receive the tree seedlings which the researchers wanted to use as a pilot project. The School also has a club of environment students. There were 150 registered students of the Environment Club in the School. The Environment Club was selected purposively given its association with the environment. About 100 (66%) students from environment club were selected using convenient sampling technique. It was assumed that since all belonged to the same club, they could therefore give the same information.

Data collection tools

The main tool employed in collection of data was the of questionnaires. In the questionnaire, questions were raised to the respondents if they were aware that trees can remove carbon dioxide from the atmosphere, protect the soils, attract rainfall and moderate atmospheric temperatures in a bid to conserve watershed quality. It was convenient to use questionnaires because students could be able to read and fill the required information provided on the questionnaire. The researcher collected the filled questionnaires, cleaned the data for processing by use of Scientific package for Social Research (SPSS).

Data Processing

The filled questionnaires were edited, cleaned, encoded and analyzed by use of scientific package for social research. The responses have been presented by use of both qualitative and quantitative statistics. The results were subjected for testing by use of chi-squares at degree of freedom (df=2) to see if the variations in the opinions of the respondents were either significant or insignificant. This was done taking Probability (P) value $P \leq 0.05$. For all the responses tested, if the 'P' values were found to be less or equal to $P \leq 0.05$, the variations in the opinions was therefore found to be significant. Cases showing that the $P \geq 0.05$, indicated insignificant relationship, hence, such views were not discussed.

4. Results and Discussions

4.0 Knowledge of the role of trees

The study investigated whether the learners had some knowledge about some of the roles played by trees such as removal and storage of carbon, protection of the soils and modification of the climate. The following were the results and the discussions.

4.1 Trees remove Carbon dioxide from the atmosphere (%)

Asked if trees help to remove carbon from the atmosphere, about 97% of the respondents agreed, 1% disagreed and 2% expressed uncertainty. The majority (97%) of the respondents are of the view that trees remove Carbon dioxide from the atmosphere. The Chi-square (χ^2= 182.420; df=2, P=0.000) shows that, the P=0.000 value is less than $P \leq 0.05$, meaning that the variations in the opinions (**Table 4.1)** of the respondents is significant. The above finding is inconformity with studies of Torn-ngern and Leksungnoen (2020), who noted that urban greening, which includes

planting trees along the streets, helps to mitigate the rising atmospheric carbon in urban areas. One way of greening is the creation of parks in cities. In another similar study, Mulligan *et al* (2023) reported that carbon removal from the atmosphere can be effectively done through reforestation, restocking, silvo-pasture, cropland agroforestry and urban reforestation. These interventions increase the green space in cities, which also provide other ecosystem services, such as clean air, shade and cooling effects, recreational and educational values. However, Krause and Zambanino (2013) cited Thomas and Martin (2011) who state that due to the complexity of tree–animal interactions in tropical rainforests, the impact of hunting on biomass carbon storage remains uncertain.

Table 4.1Trees remove Carbon dioxide from the atmosphere. (%)

Response	**Response in Absolute and Percentages terms**	
	Response in Absolute terms	**Responses in Percentages (%)**
Agree	97	**97**
Disagree	1	**1**
Not sure	2	**2**
Total	100	**100**

Percentages calculated on the basis of sample size for each category

4.2 Trees Protect Soils from Soil erosion

When asked if trees protect the soils from erosion, all the respondents 100% agreed and therefore no Chi-square test was run. The above response is in agreement with Bird *eta al* (1992) who observed that, in semi-arid and dry temperate areas, planting of 5% of the land to shelter would

bring down by 30% -50% the speed at which the wind moves and reduce soil loss by up to 80%. They further reported that the 5 per cent planted would contribute greatly to achieving the objectives such as sustainable agriculture. In addition, Hugo *eta al* (2019) reported that compared to bare soils, spontaneous vegetation plant covers reduced the runoff with 94% and 93% and declined erosion with 71% and 79%, respectively. They conclude that, it is possible to mitigate the impact of subtropical farming on terraces by adopting sustainable measures for soil and water conservation. It can therefore be noted that overall, in drier areas, trees need to be protected to maintain critical ecosystem functions related to nutrient retention in remnant woodland reserves, thus achieving a more sustainable development of agricultural systems.

Table 4.2

Response	**Response in Absolute and Percentages terms**	
	Response in Absolute terms	**Responses in Percentages (%)**
Agree	100	**100**
Disagree	0	**0**
Not sure	0	**0**
Total	100	**100**

Percentages calculated on the basis of sample size for each category

4.3 Trees attract rains from the atmosphere.

One of the questions raised about the role of the trees was if trees attract rains from the atmosphere. About 91% of respondents agreed, 4% disagreed and 5% said they were not sure. The Chi-square was (χ^2= 148.660, df=2, P=0.000). The P=0.000 value is less than P ≤ 0.05 meaning that the variations in the opinions (**Table 4.3)** of the respondents is significant. A majority (91%) of the respondents are of the view that trees attract rains. The above finding is similar to the findings of Sheil *et al*. (2009) who noted that plants with high stem volumes allow

evapotranspiration during the day thus promoting rain formation. In addition, trees have deeper roots than other vegetation forms and can thus access subterranean moisture during droughts. This makes trees to emit water into the atmosphere thus promoting rain formation. In another study Oriabure we do not use these initials intext. They apply to the reference list only (2016) reported that, forests and trees play a big role of improvement of water cycle, reduction of run off, replenishment of water table, filtration of water pollutants, control of floods and regulation of storm water.

Table 4.3 Trees attract rains from the atmosphere.

Response	**Response in Absolute and Percentages terms**	
	Response in Absolute terms	**Responses in Percentages (%)**
Agree	91	**91**
Disagree	4	**4**
Not sure	5	**5**
Total	100	**100**

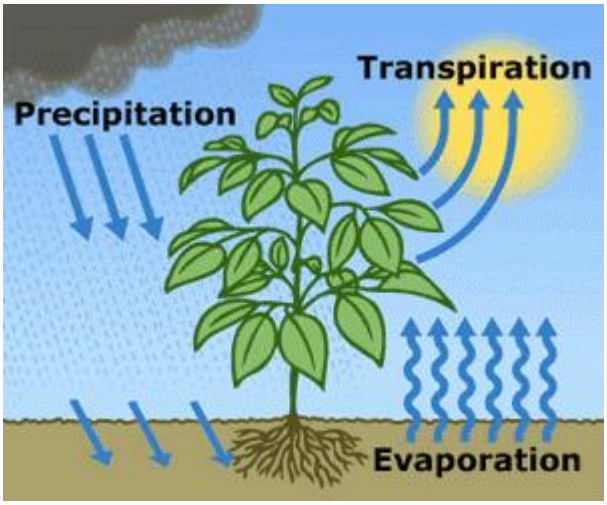
Percentages calculated on the basis of sample size for each category

4.4 Trees keep temperatures of places cool.

The respondents were asked whether trees help to moderate the atmospheric temperatures. , About 94% of them agreed, 3% disagreed and 3% were not sure. The Chi-square (χ^2= 92.160, df=2, P=0.000 and the P=0.000 value of less than P ≤ 0.05 show that the variations in the opinions (**Table 4.4)** of the respondents is significant. Mulligan eta al (2023) asserts that, the latest climate change model scenarios show that all pathways that keep temperature rise to 1.5 degrees Celsius require carbon removal. They explain that plants remove carbon dioxide from the air naturally, and trees are especially good at storing CO2 removed from the atmosphere by photosynthesis. US geological survey indicates that Essentially, evapotranspiration cools the air

by using heat from the air to evaporate water. The cooling occurs from the surrounding soil and when trees and vegetation catch rainfall with their leaves. The organization argues that on average, urban forests were 3.0° F (1.6°C) cooler than urban non-green areas. This phenomenon is represented in the evapotranspiration cycle below.

Evapotranspiration Cycle



(Credi: US Geological Survey)

Table 4.4

Response	**Response in Absolute and Percentages terms**	
	Response in Absolute terms	**Responses in Percentages (%)**
Agree	94	**94**
Disagree	3	**3**
Not sure	3	**3**
Total	100	**100**

Percentages calculated on the basis of sample size for each category

4.5 Trees add fertility to the Soil

Respondents were also asked if trees contribute to soil fertility, 94% of the respondents agreed, 3% disagreed, and 3% said they were not sure. The Chi-square value was (χ^2= 165.620, df=2, P=0.000 and the P=0.000 value was less than P ≤ 0.05 showing that the variations in the opinions of the respondents in **Table 4.5** were significant. This study is similar to that of Temegne *eta al* (2021) who said that, Soils beneath woodland trees generally support greater levels of favourable soil characteristics due to the ability of tree canopies to accumulate resources like intercepting aeolian soils and scavenging soil nutrients. There are also endogenous processes moderated by the trees, microclimatic effects due to differences in their foliage, the activity of tree-resident biotic effects on nutrient rain and the effects of animal activity. There is higher concentrations of organic matter and soluble soil **cations** what is this? in the soil below the tree canopies likely due to processes that wash nutrients from the leaf surfaces.

Table 4.5 Trees add fertility to the Soil

Response	**Response in Absolute and Percentages terms**	
	Response in Absolute terms	**Responses in Percentages (%)**
Agree	94	**94**
Disagree	3	**3**
Not sure	3	**3**
Total	100	**100**

Percentages calculated on the basis of sample size for each category

4.6Trees are homes for certain animals

About 98% of the respondents asked agreed that, trees are homes for some animals. One per cent of the respondents disagreed while 1% said they were not sure. The Chi-square (χ^2= 188.180, df=2, P=0.000). The P=0.000 value is less than P ≤ 0.05 showing that the variations in the

opinions (**Table 4.6)** of the respondents were significant. This finding is similar to the findings of Kyle et al who noted that trees also provide a critical habitat for a range of arboreal species, particularly in sparsely-timbered systems such as open woodland and savanna, and in extensively cleared agricultural landscapes (Kyle and Duncan, 2012). Tree removal in human-modified landscapes reduces landscape connectivity and habitat niches for multiple vertebrate and invertebrate species (Cadavid-Flores et al 2020). Santiago et al (2004) noted that birds benefit a lot from the dead trees. They use snags, limbs, and logs for perching, foraging, and nesting. About 30 to 45 percent of the bird species are cavity nesters in some forests. They claim that in North America alone, 55 avian species build nests in cavities. In Ohio, eastern bluebirds, American kestrels, and wood ducks are among species that rely on cavities in dead wood for successful reproduction.

Table 4.6 Trees are homes for certain animals

Response	**Response in Absolute and Percentages terms**	
	Response in Absolute terms	**Responses in Percentages (%)**
Agree	98	**98**
Disagree	1	**1**
Not sure	1	**1**
Total	100	**100**

Percentages calculated on the basis of sample size for each category

4.7 Trees act as wind breaks wind breaks

The study also tried to investigate whether trees can reduce the speed of winds. About 99% of the respondents agreed, there were no respondents who disagreed while 1% were not sure. The Chi-square was (χ^2= 96.040, df=2, P=0.000). The P=0.000 value is less than P ≤ 0.05, showing

that the variations in the opinions (**Table 4.7)** of the respondents were significant. Such a findings were reported byWorld Agroforestry Centre which observed that, one of the environmental benefits of trees are seen when trees reduced wind and increased retention of moisture. In addition, the windbreak will produce wood. However, on the negative side, some land is lost for crop production, but the reduction of wind may well compensate for the loss of land. They assert that some of the best examples of such trees include Acacia albida, Albizia and Annona senegalensis. Others include Eucalyptus spp.

Table 4.7

Response	**Response in Absolute and Percentages terms**	
	Response in Absolute terms	**Responses in Percentages (%)**
Agree	99	**99**
Disagree	0	**0**
Not sure	1	**1**
Total	100	**100**

Percentages calculated on the basis of sample size for each category

4.8Trees prevent Mass wasting on the land

The study investigated if trees prevented calamities like landslides. About 90% of the respondents agreed, 4% disagreed and 4% were not sure. The Chi-square of (χ^2= 144.560, df=2, P=0.000) showed that, the P=0.000 value is less than $P \leq 0.05$ showing that the variations in the opinions of the respondents in Table 4.8 were significant. Similar findings were reported by Sati and Sundriya. (2007). They reported that deforestation in the hilly areas is found to be the main cause of landslides. Despite the fact that vegetation cover prevents shallow surface erosion on the slopes, their (especially trees) role on prevention of deep sheeted landslides is not much justifiable. In fact, on most of the slopes in GarhwalLesser Himalaya, where thick tree vegetation

exists, repeated landslide activity is also reported. It was observed that the roots of the trees grown along the rock fractures widen the fractures on slopes and consequently failure of the rock body occurs. On the slopes, which are having pine tree vegetation, uprooting during storms is common. The pit on the surface caused by this uprooting many times become the nucleus for further slope failure. The integrated earth mass containing dense Alnus colonies, behaves as a single unit and due to aggregation of enormous weight by the unit, it ultimately slides downward. The study does not advocate selective removal of the tree species discussed above but cautions that a linear-relationship between the slope stability and extent of vegetation cover cannot be true always. At times plants may assist slope instability in a terrain, which is monsoon environment.

Table 4.8 Trees prevent Mass wasting on the land (%)

Response	**Response in Absolute and Percentages terms**	
	Response in Absolute terms	**Responses in Percentages (%)**
Agree	90	**90**
Disagree	4	**4**
Not sure	6	**6**
Total	100	**100**

Percentages calculated on the basis of sample size for each category

Conclusions

This study has established that, trees have very important role in the conservation and management of water-shed quality. Having a flourishing vegetation cover in water-shed is very important because it will help to remove and store carbon dioxide from the atmosphere, protect the soils and modify the climate of the agriculture dominated catchment landscape. Conservation and restoration of trees in Manafwa catchment should be given priority as a way of striving to achieve quality fresh water and long-term sustained production of agriculture.

Involvement of all the stake-holders should be highly considered and school children given sensitization opportunities since the future belongs to them.

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