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RESEARCH ARTICLE

ECOSYSTEM SERVICES OF KAKAMEGA TROPICAL RAINFOREST ECOSYSTEM OF KAKAMEGA COUNTY, KENYA

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Abstract

The main objective of this study was to analyze ecosystem services of Kakamega Tropical Rainforest. This study was descriptive and cross-sectional in design and relied on a mixed methods methodology. Anthropogenic Global Warming Theory and Adaptive Management Theory were used to guide the study. A conceptual framework showing the interrelationship between the dependent and independent variables was outlined. The study utilized both secondary and primary data. The target population was 200 households living up to 10 km from the forest edge in the selected communities neighbouring Kakamega Tropical Rainforest and 20 government officials within Kakamega County. A total of 119 members of the households and 20 forest officers were sampled as respondents in the study. The study findings revealed that the forest ecosystem was a source of many services to the surrounding community, it also had a great impact on the surrounding community. The study recommended that there is need to conserve the forest since it was a source of many services to the surrounding communities and that the forest ecosystem also helped to adapt or mitigate climate change among others.

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Introduction:-

The idea of ecosystem services is relatively a new science (Fisher et al., 2009) however, developing quickly, particularly after the initiative of Millennium Ecosystem Assessment. The idea of ecosystem service includes both the goods and services that are utilized by human populace. Examples of goods include: production of timber, fuel, fish, crops and fodder; examples of services on the other hand include: storm protection, flood control, cloud formation, and greenhouse gas regulation (Egoh et al., 2010). At the same time, life sustaining goods and services are essentially ecosystem services. To do so, they set the condition of “directly consumed” to be as final ecosystem services. More recently, Fisher et al., (2009) considered all services either directly consumed or indirectly consumed as ecosystem services.

Ecosystem services research is still in the evolving phase of development across the world. Internationally, researchers have been evaluating various aspects of Ecosystem Services, for example, quantifying and mapping Ecosystem Services (Anderson-Teixeira et al., 2012; Deng et al., 2011; Egoh et al., 2008; Eigenbrod et al., 2010; Kalacska et al., 2008; Li et al., 2011; Naidoo et al., 2008), developing practical frameworks for the appraisal of Ecosystem Services (Posthumus et al., 2010), describing the nature of relationships between Ecosystem Services and biodiversity (Egoh et al., 2009; Egoh et al., 2010) and creating models, (for example, InVEST) and web-based

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tools, (for example, ARIES) for Ecosystem Services analysis (Johnson et al., 2012; Nelson et al., 2009; Youn et al., 2011).

People benefit in various ways from ecosystems and the services they offer. While it has been the subject of investigation since the mid-twentieth century, the idea itself gained most of its popularity through the work of the Millennium Ecosystem Assessment in 2005 in which 1300 researchers explored the status of the ecosystem services in a momentous work (Fisher, 2008).

The findings of MA's study was that 15 of the 24 ecosystem services internationally are declining and that negative impact on human welfare is likely to be experienced in the future. The appraisal suggested for heightened research in measuring, modelling and mapping of ecosystem services. By doing so, the 1300 researchers moved the science encompassing the idea significantly forward and stirred the desire for many that this framework would give a new and generous source of conservation financing. It started a great volume of work being conducted in the field (Simpson, 2011). The same scenario has also been reported from the temperate forested landscapes and from forests in California (Shaw et al., 2011). We are still unclear about what will be the pattern for tropical forest ecosystem services under future climate change scenarios. Over the period 1880 to 2012, the mean global surface temperature has increased by 0.85°C (IPCC, 2014).

Ecosystem services are at the focal point of the idea of Ecosystem-based Adaptation. Since the publication of two seminal studies about ecosystem services two decades ago various categorization systems were produced for policymaking, scientific analysis, and economic valuation. Four classifications of ecosystem services are now broadly distinguished (Costanza et al., 2017): supporting, regulating, provisioning and cultural services. However, harnessing these services often requires combination of ecological processes with built, human and social capital.

First and foremost, provisioning services, combined with built, human and social capital, produce, for example, timber, fibre and food. Secondly, regulating services, combined with built, human and social capital, produce water regulation, human disease regulation, flood control, storm protection, water purification, pest control, air quality maintenance, climate control and pollination (Costanza et al., 2017). Thirdly, cultural services, combined with built, human and social capital, offer cultural identity, recreation, scientific, aesthetic, sense of place, or other 'cultural' benefits. Lastly, supporting services describe the basic ecosystem processes such as provisioning of habitat, nutrient cycling, soil formation and primary productivity. They contribute indirectly to human wellbeing by maintaining the processes and functions necessary for provisioning, regulating, and cultural services (Costanza et al., 2017).

Ecosystem services vary with regard to their private or public good attributes that is whether their consumption is excludable and rival. Most provisioning services are 'private goods', or can at least be privatized, that is individuals or private enterprises control the means of production and supply chains (Paudyal et al., 2016). On the contrary, most regulating services are 'public goods' that is goods that are non-excludable and from which multiple users can simultaneously benefit. Most cultural services consist of a mix of private and public goods (Costanza et al., 2017; Paudyal et al., 2016). Some elements of adaptation to climate change are public goods, for example, the conservation of important habitats and common cultural heritage.

The idea of ecosystem services is usually utilized these days to show the connection between the functioning of ecosystems to human prosperity (Fischer et al., 2009). For example, Ecosystem services as the conditions and processes through which natural ecosystems and their constituent species support and satisfy human life; Ecosystem services as the advantages human populace derive, directly or indirectly, from ecosystem functions; Ecosystem services as the benefits individuals get from ecosystems, and Ecosystem service as the ecological components/ items directly consumed or enjoyed to contribute to human prosperity.

Fischer et al., (2009) contend that any endeavor at classifying ecosystem services ought to be a function of both ecosystem and ecosystem service attributes. The decision making context for this is determined by the following: benefits from rival and excludable goods, spatial and temporal dynamism of ecosystems and their services, multiple services produced by multiple ecosystems, ecosystem complexity structure, process and service, and benefits dependent upon understanding of ecosystem services.

For the majority, ecosystem services is a promising strategy to look at nature from a more economic point of view – a strategy that would enable pricing of nature. The expectation is that ecosystems and their services would get a

different sort of thought in the political field if it would be possible to put a hard monetary number on an ecosystem service. For instance, if it would be possible to assess the value of the water filtration that a certain ecosystem in a region provides were it preserved, this number could potentially be compared to alternative options to purify the water (Chong, 2014).

Supporters of the idea contend this would be a good method of quantifying the value of ecosystems and by doing so, it would give sound economic reasons for conservation. This line of argument is easy to follow and makes a lot of sense at first glance, but what if an assessment reveals that the monetary value of the services of a certain ecosystem is incredibly low, would this automatically mean that this environment is not worth protecting? What about intrinsic values of nature, could they be accounted for? This is one of the core criticisms that the concept receives – it fundamentally adopts a utilitarian, anthropocentric conceptualization of the relationship between ecosystems and human well-being (Chong, 2014).

Technical and ethical constraints are being ascribed to the operationalization of the ecosystem service structure in the processes of decision making (Adams and Redford, 2009). Conservationists articulate the fear that if governments and businesses can be persuaded to mainstream monetary evaluation of ecosystem services, they are likely to do their sums rather quickly. This may lead to a scenario in which diverse ecosystems that produce economic returns will be preserved and those that do not would be either converted or transformed in order to increase returns (Adams and Redford, 2009).

The discussion surrounding the framework highlights the challenges of balancing ecocentric and anthropocentric views regarding biodiversity conservation and ecosystem management (Chong, 2014). The discussion sets aside the framework and has managed to point out the essential services ecosystems provide and received international attention by communities and decision makers – successfully increasing the significance of nature conservation on policy agenda globally (Chong, 2014). In relation to Ecosystem-based Adaptation, Chong (2014) states that:

”Ecosystem-based Adaptation, as an extension of the ecosystem services framework, similarly has the potential to inspire efforts to confront the impacts of climate change and acknowledge the importance of nature to supporting societal adaptation”.

Majority of countryside households in developing countries and Kenya specifically are predominantly engaged in diverse livelihood strategies and activities. One of these ways is the extraction of forest products and it gives a substantial contribution to their well-being (Babulo et al., 2009). Other livelihood ways include trading, livestock husbandry, crop cultivation and unskilled jobs. A livelihood is defined as comprising ‘the capabilities, assets and activities required for a means of living’ (Babulo et al., 2009). Livelihoods are considered to be sustainable when they can cope with and recover from stress and shocks and maintain or enhance their capabilities and assets both now and later on.

In recent years, the importance of non-timber forest products (NTFPs) commercialization as a technique to reduce poverty and conserve forests has become prominent (Brown and Lassoie, 2010) as the dependence of poor rural livelihoods on forest income increases. Likewise, Babulo et al., (2009), after sampling 360 rural households in 12 villages in northern Ethiopia, found that income from forest products occupied the second largest share of the mean total household income after crop income. Numerous governments in Africa also value timber production for income generation more than any other forest ecosystem services, whereas livelihoods in many rural communities in Africa depend to a greater extent on NTFPs for subsistence and income generation (Babulo et al., 2009). This is similar with the international pattern for which the highest proportion (30%) of the functions of the world’s forests is designated for production of timber and also NTFPs (FRA, 2010).

The human effect on planet Earth is increasing quickly, with regard to both scale and intensity (Steffen et al., 2011, Malhi et al., 2014). One of the significant human-instigated impact is worldwide climate change. To keep climate change within safe limits (Rockstrom et al., 2009), global leaders have been discussing alternatives to mitigate and adapt. A significant step was made during the Conference of the Parties (COP) of the United Nations Framework Convention on Climate Change (UNFCCC), in December 2015 in Paris. Here, 196 nations agreed to lessen greenhouse gas emissions and increase Carbon dioxide removal from the atmosphere, with the ultimate objective to keep worldwide temperatures from rising by more than 2°C (United Nations, 2015). Carbon dioxide removals from the atmosphere are naturally done by growing vegetation, through the process of photosynthesis. Vegetation types

that store and remove a lot of Carbon dioxide, for example, tropical forests, are therefore highly relevant for climate change mitigation.

Tropical forests contribute to climate change mitigation in three different ways. In the first place, biomass in tropical forests contains about 25% of all carbon on just about 12% of the region in the terrestrial biosphere, which implies that forestalling deforestation and forest degradation can lessen Carbon dioxide emissions. Second, tropical forests are Carbon dioxide 'sinks', implying that they remove net Carbon dioxide from the atmosphere, and utilize this in photosynthesis to produce additional aboveground and belowground biomass (Brienen et al., 2015, Poorter et al., 2016).

During the early twentieth century, standing old-growth tropical forests removed 1-1.2 Pg carbon y⁻¹ and regrowing (or secondary) forests another 1.2-1.7 Pg y⁻¹, which was about 24% of the worldwide yearly anthropogenic carbon emissions (Canadell and Schulze 2014, Goodman and Herold 2014). Third, tropical forests reduce worldwide temperatures because of high evapotranspiration rates. High evapotranspiration directly affects temperatures through evaporative cooling, and an indirect impact through increasing cloud and rainfall formation and sunlight reflection which, in turn, decrease global temperatures (Alkama and Cescatti 2016).

A part from their climate mitigation capacity, tropical forests are crucially important for various other functions that are relevant at local and global scales, such as timber and non-timber forest products and pollination (Alkama and Cescatti, 2016). Globally, the livelihood of more than a billion people depends directly on forests (FAO, 2016), with most of them living in the tropics. Forest functioning ultimately depends on ecosystem processes, which are fluxes of carbon, water and nutrients at the ecosystem level. To guarantee forest functioning, we thus need to understand what mechanisms determine ecosystem processes.

Tropical forests are significant in addressing global climate change (Lewis et al., 2009). At the global level, forest ecosystems could play a significant role in atmospheric carbon sequestration. On the other hand, vulnerable poor communities rely upon forest goods and services to adapt to impacts of climate change at the national and local levels, which the current study addresses. The idea of ecosystem services gained more attention after the Millennium Assessment defined it (TEEB Foundations, 2010; TEEB Synthesis, 2010; Ninan, 2014).

Ecosystem services got from the natural capital, which adds to accomplish human prosperity by interacting with built capital (financial and manufactured capitals), social capital, human capital and natural capital (Ninan, 2014). However, human well-being, livelihoods and ecosystems around the globe are being threatened by climate change and climate related disasters (Lo, 2016).

The MA (2005) illustrated ecosystem services as the benefits people acquire from ecosystems. This idea is easily comprehended and conceptually simple but covers most of the services benefitting humanbeings; hence the MA approach is widely utilized in ecosystem services research (Baral et al., 2014; Burkhard et al., 2012; Pert et al., 2015).



Figure 2.3:- The Kakamega Tropical Rainforest is a magnificent habitat for biodiversity
Source: Researcher (2019).

The supply of ecosystem services in a forested landscape varies due to differences in vegetation type and cover (Burkhard et al., 2012; de Groot et al., 2010), and environmental factors and forest management systems (Palomo et al., 2013). The interaction among ecosystem services may also be different depending on the ecosystem services under consideration (Harrison et al., 2014). Therefore, a solid understanding of the distribution of ecosystem services across the forested landscape, together with quantifying interactions between ecosystem services and environmental drivers is enormously important.

However, very little is known about ecosystem services science in tropical forests (Alamgir et al., 2014; Seppelt et al., 2011; Seppelt et al., 2012). The heterogeneous tropical forested landscape of the Kakamega Tropical Rainforest may provide an opportunity to understand the process and interactions of multiple ecosystem services supply, thereby contributing to this knowledge gap.



Figure 2.4:- The damage of forest canopies in the Kakamega Tropical Rainforest.

Source: Researcher (2019).

Kakamega Tropical Rainforest includes a large variety of ecosystems (Pittock et al., 2012) and its natural ecosystem is one of the most vulnerable segment to climate change (Smith and Ash, 2011). Under the most recent climate change projections (IPCC, 2014), the ecosystem services supply from forested landscapes is likely to be under more pressure in this century. However, the trend is yet to be explored for most terrestrial forest ecosystems, particularly for remaining areas of tropical forest of global significance.

Each forest type forms a habitat for a specific community of animals that are adapted to live in it. The term forest implies ‘natural vegetation’ of the region, existing from thousands of years and supporting a variety of biodiversity, forming a complex ecosystem. Forests provide various natural services and products. Many forest products are used in daily life, play important role in maintaining ecological balance, and contributes to economy (State of Environment Report – India, 2009).

Tropical rainforest assumes a significant role in the worldwide carbon cycle (Huntingford et al., 2013), accounting for a large portion of global Net Primary Productivity (NPP) and bringing down atmospheric CO₂ levels. The Central American rainforests are mainly found on the Caribbean watersheds of Panama, Costa Rica, Honduras, Belize, and southern Mexico. The area is a global biodiversity hotspot that is highly threatened by change of land use. In Central America, impacts like those that happened during El Nino years are likely to increase under future climatic scenarios (Karmalkar et al., 2011). Similar to the Amazon, Central America is subject to potentially large losses of forest biomass under increased drying and warming scenarios in the twenty-first century (Lyra et al., 2016; Imbach et al., 2012).

The MA (2003, 2005) was the first global dynamic and integrated document that reported on Ecosystem Service research globally. It established Ecosystem Service as a policy tool for sustainable natural resource management (Seppelt et al., 2011) as well as providing scientific evidence for policy makers about the consequences of changes of Ecosystem Service to human wellbeing (Pert et al., 2010). Scientists and policy makers have continued to conduct

further ES research as of late (Fisher et al., 2009). For instance, Seppelt et al.'s (2011) global review on ES studies evaluated the current trend, spatial distribution, weakness and future direction of ES research, whilst Egoh et al., (2007) completed a global review on ES studies, focusing on conservation assessment.

Many studies refer to the key role of ecosystems in climate change adaptation and disaster risk reduction, since ecosystems provide many ecosystem services, including: natural protection against hazards, climate and water regulation, carbon sequestration, and pest regulation. In addition to this, management of ecosystems increases the resilience of the ecosystems and communities to climate change and disasters (Munang et al., 2013).

Discussion of Research Findings:-

The objective of this study was to analyze the ecosystem services of Kakamega Tropical Rainforest. In order to answer the question related to this objective, the researcher sought some responses from both the members of the households as well as the forest officers in relation to this question as shown in Table 4.3 below.

Table 1:- Ecosystem Services of Kakamega Tropical Rainforest of Kakamega County, Kenya.

ITEM	CATEGORY	Agreed		Undecided		Disagreed		Total	
		F	%	F	%	F	%	F	%
Ecosystem services of the forest is source of Timber	HM	16	31.4	13	10.9	90	75.7	119	100
	FO	20	100	-	-	-	-	20	100
Ecosystem services of the Forest is source Firewood	HM	100	84	11	9.2	8	6.8	119	100
	FO	17	85	3	15	-	-	20	100
Ecosystem services of the Forest is source of Herbal Medicine	HM	90	75.7	15	12.6	14	11.7	119	100
	FO	16	80	4	20	-	-	20	100
Ecosystem services of The Forest is source of Fodder for Livestock	HM	89	74.8	10	8.4	20	16.8	119	100
	FO	18	90	2	10	-	-	20	100
Ecosystem services of The Forest is source of Food	HM	26	21.8	18	15.1	75	63.1	119	100
	FO	17	85	3	15	-	-	20	100
Ecosystem services of the Forest prevents Storms	HM	81	68.1	4	3.4	34	28.5	119	100
	FO	20	100	-	-	-	-	20	100
Ecosystem services of the forest helps to Control Floods	HM	89	74.8	14	11.8	16	13.4	119	100
	FO	19	95	1	5	-	-	20	100
Ecosystem services of the forest helps in Cloud Formation	HM	98	82.4	11	9.2	10	8.4	119	100
	FO	20	100	-	-	-	-	20	100
Ecosystem Services of the forest helps in Greenhouse Gas Regulation.	HM	73	61.3	26	21.8	20	16.9	119	100
	FO	15	75	5	25	-	-	20	100

KEY: HM- Household members. FO-Forest Officers.

When the members of the households were asked if the services, they received were a source of timber, a majority at 90 (75.6%) disagreed, a few 16 (13.4%) agreed while 13 (10.9%) were undecided. When the same was posed to the forest officers the opposite was true, with all the 20 (100%) agreeing that people used the forest as a source of timber. This agrees with the views of Costanza et al., (2017) who argues that first, provisioning services, combined with built, human and social capital, produce, for example, food, timber and fiber. Second, regulating services, combined with built, human and social capital, produce flood control, storm protection, water regulation, human disease regulation, water purification, air quality maintenance, pollination, pest control, and climate control. Third, cultural services, combined with built, human and social capital, offer recreation, aesthetic, scientific, cultural identity, sense of place, or other 'cultural' benefits. Finally, supporting services describe the basic ecosystem processes such as soil formation, primary productivity, nutrient cycling and provisioning of habitat. They contribute indirectly to human wellbeing by maintaining the processes and functions necessary for provisioning, regulating, and cultural services (Costanza et al., 2017).

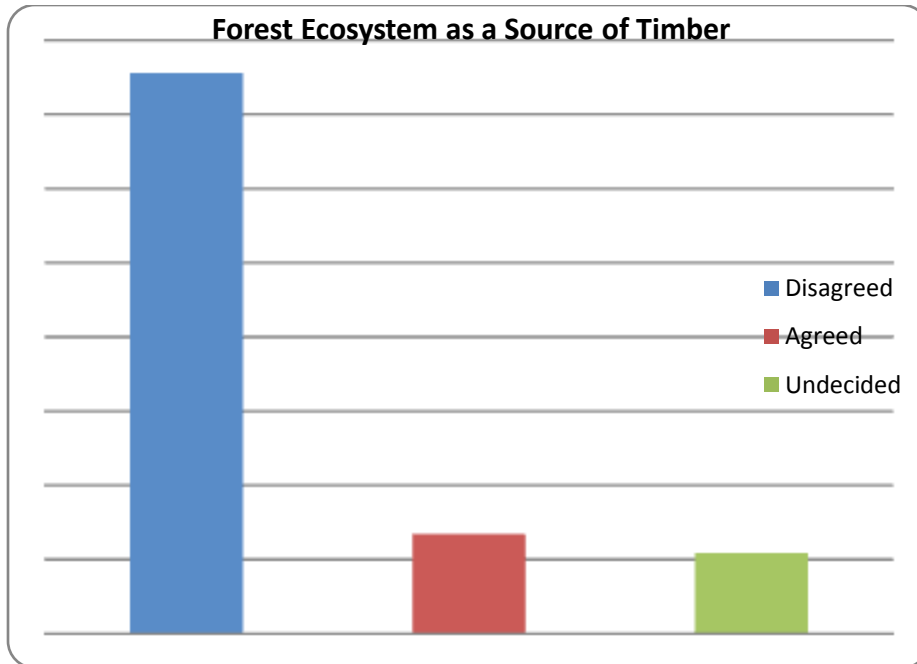


Figure 3:- Forest Ecosystem as a Source of Timber.

When the members of the households were asked if the forest ecosystem is used as a source of herbal medicine, a majority at 90 (75.7%) agreed, a few at 14 (11.7%) disagreed, while 15 (12.6%) were undecided. On the other hand, 16 (80%) of the forest officers agreed to the same question and only 4 (20%) were undecided. This agrees with the views of Costanza et al., (2017) that the forest ecosystem is used as a source of herbal medicine.

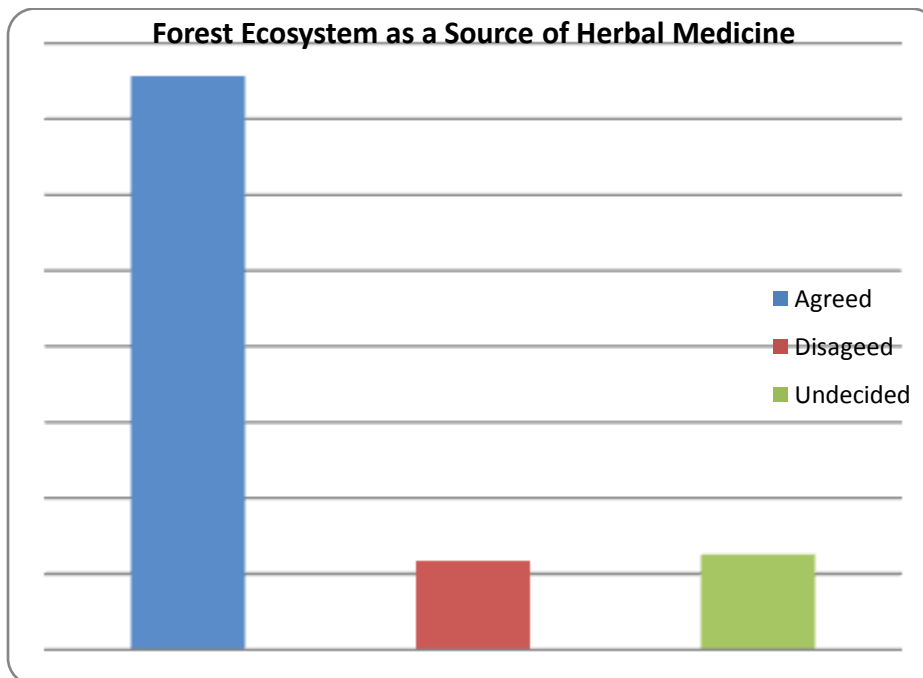


Figure 4:- Forest Ecosystem as a Source of Herbal Medicine.

When members of the households were asked if the forest ecosystem is used as a source of fodder for animals, a majority at 89 (74.8%) agreed, 20 (16.8%) disagreed while 10 (8.4%) were undecided. On the other hand, a majority at 18 (90%) of the forest officers agreed and only 2 (10 %) were undecided.

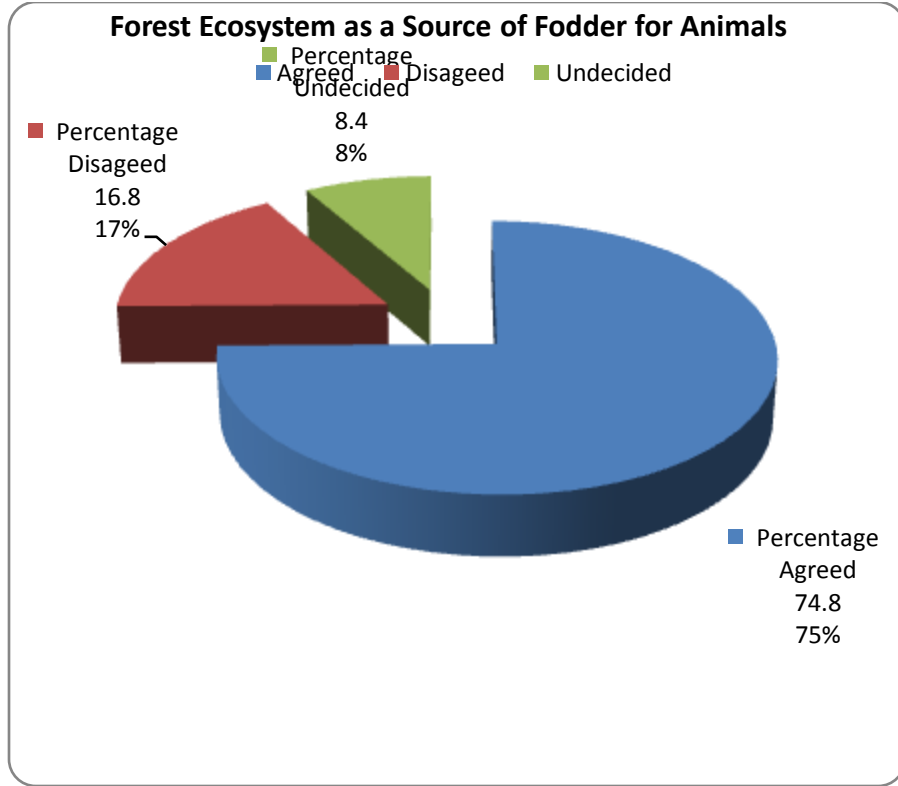


Figure 5: Forest Ecosystem as a Source of Fodder for Animals

On the issue of firewood, a majority at 100 (84%) of the household members agreed that the forest ecosystem provided firewood, 11 (9.2%) were undecided while 8 (6.8%) disagreed. On the other hand, a majority at 17 (85%) of the forest officers agreed and only 3 (15%) were undecided.

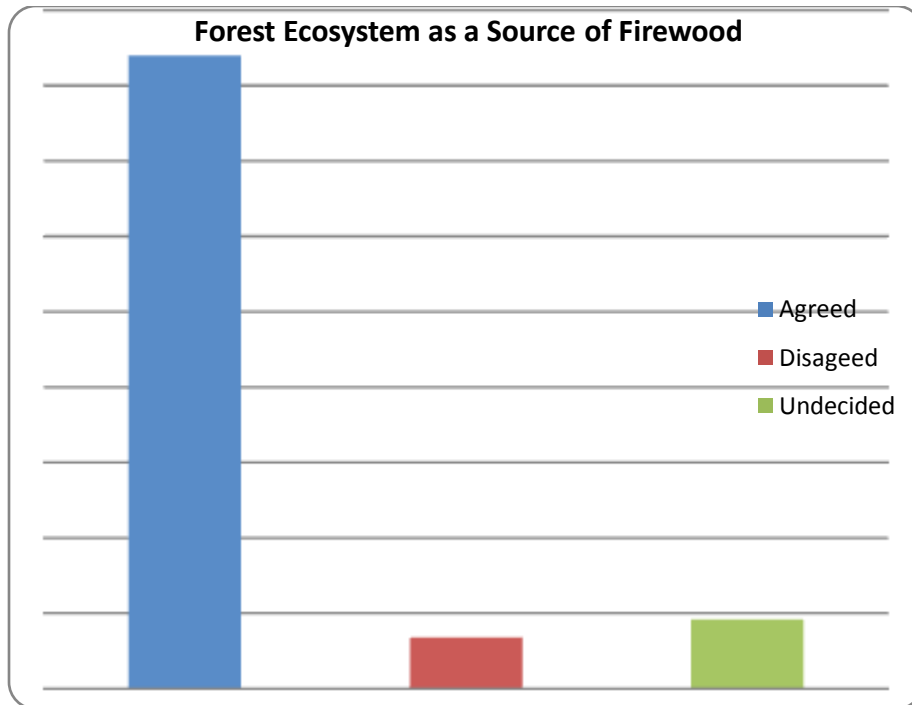


Figure 6: Forest Ecosystem as a Source of Firewood

On whether the forest ecosystem provided food, a majority 75 (63.1%) disagreed, 26 (21.8%) agreed while 18 (15.1%) were undecided. On the other hand, a majority at 17 (85%) of the forest officers agreed, while only 3 (15%) were undecided.

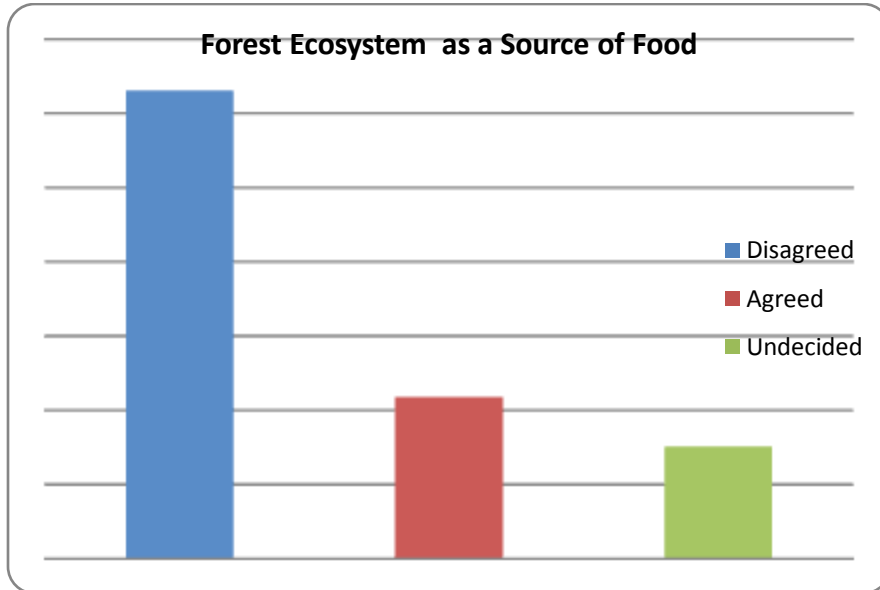


Figure 7:- Forest Ecosystem as a Source of Food.

When members of the household were asked if the forest ecosystem prevented storms, a majority at 81 (68.1%) agreed, 34 (28.5%) disagreed, while only 4 (3.4%) were undecided. On the other hand all the 20 (100% of forest officers agreed that the forest ecosystem indeed prevented storms.

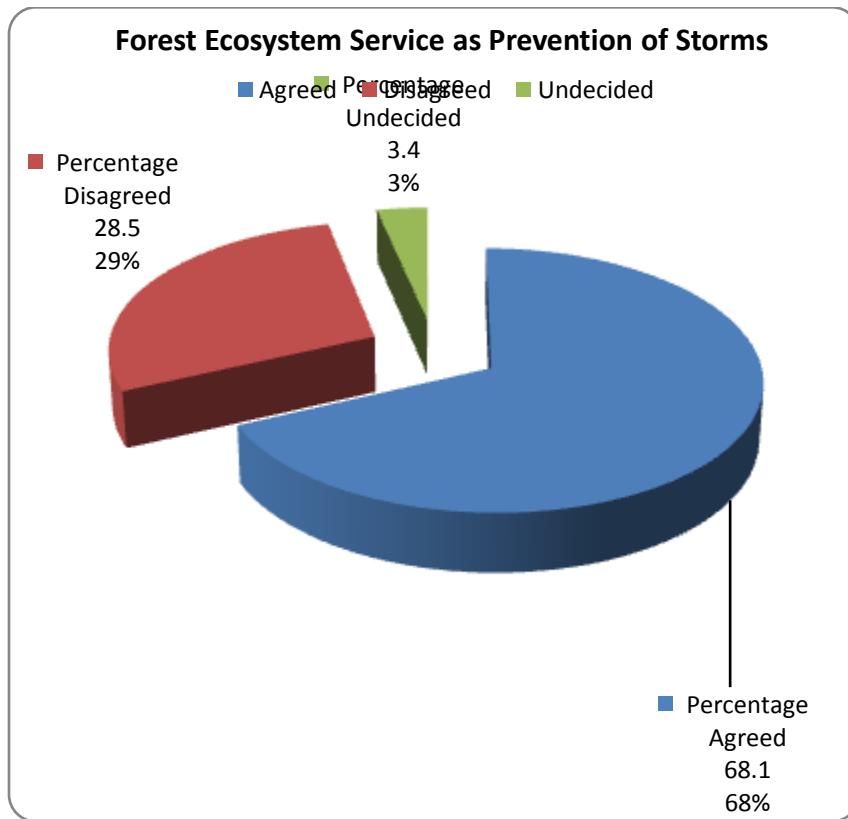


Figure 8:- Forest Ecosystem Service as Prevention of Storms.

When asked if the forest ecosystem service was to control floods, a majority at 89 (74.8%) of the members of the households agreed that it indeed controlled floods, a few at 16 (13.4%) disagreed while only 14 (11.8%) were undecided. On the same question a majority at 19 (95%) of the forest officers agreed and only 1 (5%) was undecided. This shows that the forest ecosystem controls floods, which agrees with the views of Costanza et al., (2017).

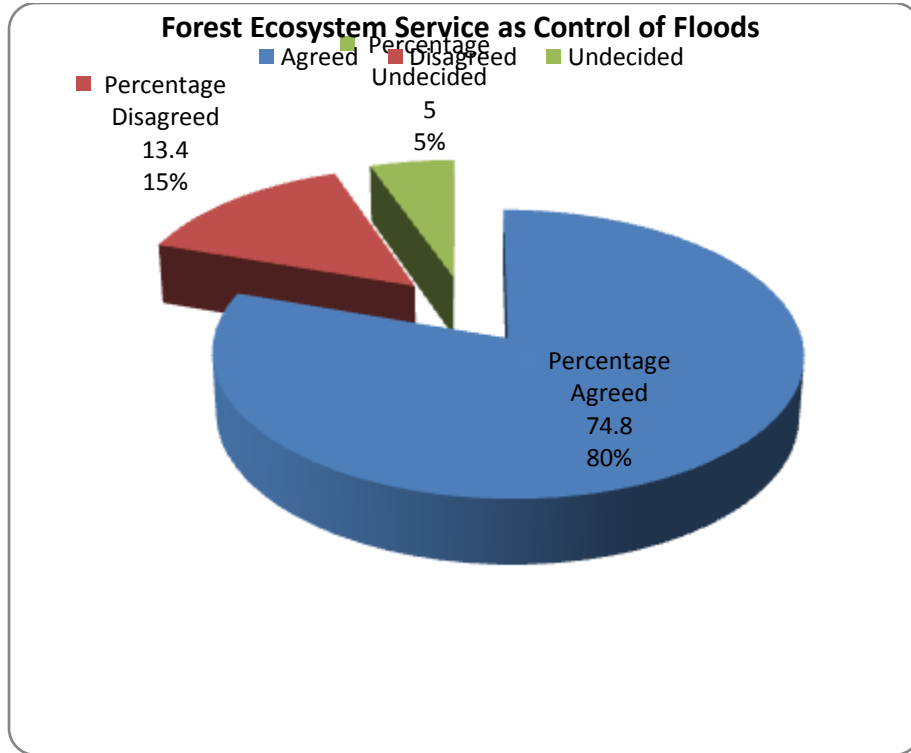


Figure 9:- Forest Ecosystem Service as Control of Floods.

When the members of the households were asked if the forest ecosystem helps in cloud formation a majority at 98 (82.4%) agreed, a few at 10 (8.4%) disagreed while 11 (9.2%) were undecided. On the other hand, all the 20 (100%) of the forest officers agreed on the same question. This agrees with the views of Costanza et al., (2017) that forests help with cloud formation and precipitation.

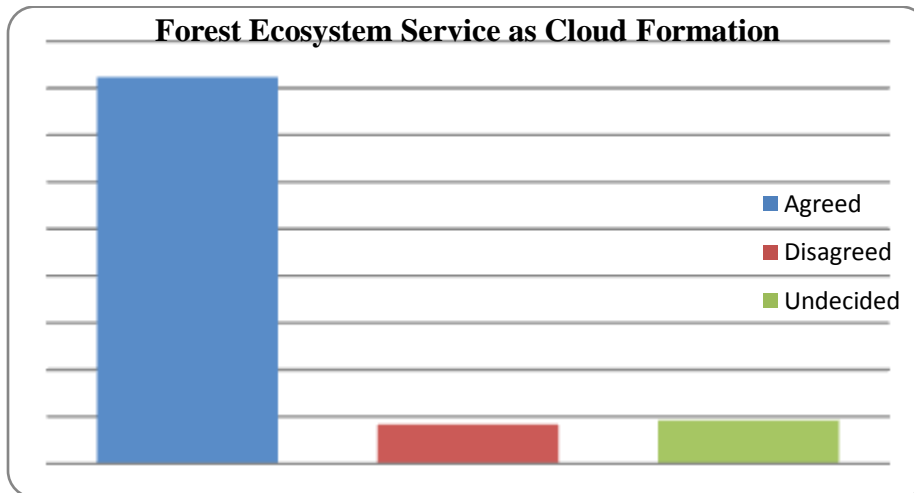


Figure 10:- Forest Ecosystem Service as Cloud Formation.

When the members of the household were further asked if the ecosystem helps in greenhouse gas regulation, a majority at 73 (61.4%) agreed, 20 (16.8%) disagreed, while 26 (21.8%) were undecided. On the other hand 15 (75%) of the forest officers agreed on the same question, while only 5 (25%) were undecided. This agrees with the views of Costanza et al., (2017) that forests indeed regulate greenhouse gases in the atmosphere.

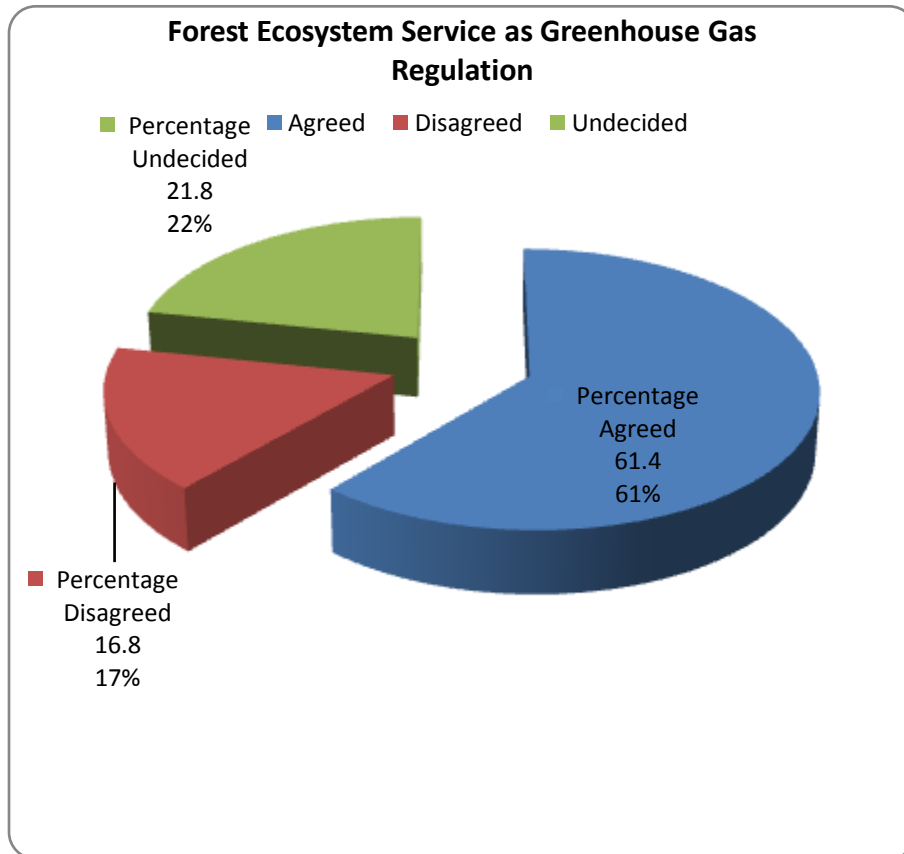


Figure 11:- Forest Ecosystem as Greenhouse Gas Regulation.

Summary of the Findings:

Majority of the members of the households disagreed that the services they received from the forest ecosystem were a source of timber however, when the same question was posed to the forest officers, the opposite was true, with all the twenty forest officers being in agreement with the fact that people used the forest as a source of timber. This agrees with the views of Costanza et al., (2017).

As a source of firewood, majority of the household members agreed that the forest ecosystem indeed assisted them as a source of firewood. This was also in agreement with forest officers who all agreed that the forest ecosystem was indeed used as a source of firewood. This agrees with the views of Costanza et al., (2017) that people use the forest as a source of firewood.

When the members of the households were asked if the forest ecosystem was used as a source of herbal medicine, a majority of them were in agreement. This was also true for the forest officers who also agreed with the same question. This agrees with the views of Costanza et al., (2017) that the forest ecosystem is used as a source of herbal medicine.

When members of the households were asked if the forest ecosystem is used as a source of fodder for livestock, a majority of them were in agreement. A majority of the forest officers also agreed that indeed the forest ecosystem was used as a source of fodder for livestock. This agreed with the views of Costanza et al., (2017) that the forest ecosystem is used as a source of fodder for livestock.

Again, when the members of the households and forest officers were asked if the forest ecosystem was used as a source of food, both categories of respondents agreed that the forest ecosystem was indeed used as a source of food.

When both the members of the households and forest officers were asked if the forest ecosystem prevents storms, a majority of the household members agreed while all the twenty forest officers interviewed agreed that the forest ecosystem indeed prevents storms. These views agree with those of Costanza et al., (2017) who argue that the forest ecosystem prevents storms.

When asked if the forest ecosystem controls floods, a majority of both the members of the households and forest officers agreed that it indeed controlled floods. This shows that the forest ecosystem control floods, which agrees with the views of Costanza et al., (2017).

When the members of the households and forest officers were asked if the ecosystem service helps in cloud formation, a majority of both categories of the respondents agreed on the same question. This agrees with the views of Costanza et al., (2017) that forests help with cloud formation and precipitation.

When the members of the households were further asked if the ecosystem helps in greenhouse gas regulation, a majority of both the household members and forest officers agreed. This agrees with the views of Costanza et al., (2017) that forests indeed regulate greenhouse gases in the atmosphere.

Conclusions:-

Kakamega Tropical Rainforest is a source of many ecosystem services to the surrounding community; timber, firewood, herbal medicine, fodder for livestock, prevent storms, control floods, cloud formation and greenhouse gas regulation.

Recommendations:-

There is need to conserve the Kakamega Tropical Rainforest as it is a source of many services to the surrounding community such as timber, firewood, herbal medicine, fodder for livestock, prevents storms, control floods, cloud formation and greenhouse gas regulation.

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