Communal Non-Consumptive Natural Resources Conservation Practices in Western Tanzania

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Abstract

The communal-indigenous non-consumptive natural resources conservation practice contribution on community economy in western Tanzania was studied. The study focused on forest and wildlife because they are most affected by land conversion and degradation. An economic benefit model of the communal-indigenous non-consumptive natural resources conservation practice effect was developed. To assess magnitude of effect of the practice, specific null hypothesis (H_2) was developed and tested. The null hypothesis stated that H_2: Communal-indigenous non-consumptive terrestrial natural resources management approach does not significantly impact community economic benefit. The empirical study administered a four point-scaled numerical survey questionnaire to 400 respondents and 40 Key Informant Interviews. Quantitative data were analyzed by SPSS while qualitative data were analyzed by Excel framing summarizing technique. Descriptive statistics realized that the communal non-consumptive natural resources conservation mean was 46.99, almost equal to the average mean of 47. Moreover, the model had strong linear relation. Pearson (r) covariance statistical relationship correlation coefficient of Pearson (r) = 0.68, $p<.001$. Furthermore, the contribution of communal-non-consumptive natural resources conservation practice on community economic benefit was calculated through multiple linear regression techniques. Multiple linear regression results showed that regression coefficient B= 1.34 at 95% confidence interval (CI) = 1.23, 1.44; p=0.000. The result implied that an increase of one unit of the communal non-consumptive natural resources conservation practice was associated with an increase of 1.34 community economic benefit (CEB). The study results rejected the null hypothesis suggesting that the alternative hypothesis may be true. The study concludes that communal non-consumptive management approaches likely significantly impact community economic benefit (CEB). Therefore, to enjoy strong community economy, communal-non-consumptive natural resources conservation should be given significant attention. Additionally, to gain more community economic benefit, an integrated hybrid combo of consumptive approaches such as sustainable timber with non-consumptive approaches such as avoided deforestation and degradation and increased carbon sequestration credit is recommended.

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Keywords: Natural resources management, community economic benefit (CEB), communal-indigenous non-consumptive natural resources management, natural resources utilization, Greater Mahale Ecosystem (GME), Tanzania.

1.0 INTRODUCTION

In predominantly rural areas such as Greater Mahale Ecosystem (GME), Tanzania experienced poor economic welfare and retarding economic growth up to 2.5% in 2017 and 2.3% in 2018 (URT, 2012; Leisher & Hess, 2017; World Bank Report, 2019). Poor economic welfare in the least developing countries rich in natural resources is a continued world agenda (CBD, 2011, UNEP-WCMC, 2018; COP 26, 2021). Less economic benefit from natural resources management has been achieved regardless of effort from many economists, including high-profile ones such as Nobel Laureate Ken Arrow (Arrow *et al.,* 1995; Ribot, 2003). Economists' efforts resulted into economic considerations of local communities-indigenous in natural resources conservation (CBD, 2011; UNEP- WCMC, 2018; COP 26, 2021). Less achievement in conservationists-economists' efforts is marked in low income to marginalized rural communities' who mostly depend on a common-pool resource (CPR). Such a trend brings questionability to sustainable natural resources management (Kerapeletswe and Lovett; 2005; Murphree, 2009; Bluwstein*et al.*, 2016; COP 26, 2021). Regardless importance of economic benefits from conservation interventions, fewer studies have been conducted on natural resources management's impact on the community economy (UNEP – WCMC, 2018). Following a few studies on natural resources management-economic benefit, UNEP – WCMC (2018) report called for assessing the flow of economic benefit from conservation as a priority. This paper focuses on the impact of collective non-consumptive natural resources management on community economic benefit.

Tanzania's communal-indigenous natural resources management approaches started long ago, before the colonial era (Pailler *et al*., 2015). Communal-indigenous natural resources management is among current approaches of conservation in a form of Co-management in Tanzania (URT, 1998a; URT, 1998b; URT, 2009). Other practiced conservation approaches are private, and public natural resources management. Different resources management approaches are necessary because Tanzania have vast terrestrial ecosystems traversing community and public lands (Taylor, 2011). Additionally, Tanzania has beautiful vegetative ecosystems such as equatorial forests, acacia woodlands, miombo woodlands, tropical forests, mountain forests and grasslands (Bluwstein, 2017). Furthermore, Tanzania has appealing large grassland ecosystems such as Serengeti plains, Miombo woodland like Greater Mahale and Mountain Ecosystems such as beautiful Mount Kilimanjaro (Taylor, 2011). Also, Tanzania has a diversity of wildlife with all big five (Elephant, Lion, buffalo, giraffe, and rhino), amazing migratory wildebeest, endangered chimpanzee, and beautiful colobus monkey (URT 2009; Taylor, 2011; Piel*et al.,* 2013; Morrison *et al.,* 2016). All the Tanzanian six ecoregions, including the Western Tanzania ecoregion, carry the natural beauty with vast flagship fauna such as chimpanzee and flora like Zambezian miombo woodland (John *et al.,* 2019).

Tanzania formulated natural resources policies such as wildlife and forest policies that recognize communal natural resources management approaches (URT, 1998a; URT, 1998b). The wildlife policy of Tanzania (URT,1998a) one of its strategy states that "involving rural communities and other stakeholders in taking joint responsibility for the sustainable management of wildlife and other natural resources". Moreover, the wildlife policy (URT, 1998a) states that "to transfer management of Wildlife Management Areas (WMA) to local communities thus taking care of corridors, migration routes and buffer zones and ensure that local communities obtain sustainable, tangible benefits from wildlife conservation". Whereas the forest policy of Tanzania (URT,1998b) in the sixteenth policy statement states, "Involvement of local communities and other stakeholders in conservation and management will be encouraged through joint management agreements". Furthermore, the forest policy of Tanzania's (URT,1998b) thirty-ninth policy statement states that "local communities will be encouraged to participate in forestry activities". However, both wildlife and forest policies (URT 1998a; URT 1998b) did not explain the economic benefits of natural resource conservation. This paper's interest is to explain community economic benefit accrued from communal-indigenous non-consumptive natural resources conservation in Greater Mahale Ecosystem in Western Tanzania.

Demand and utilization of natural resources informed by management approaches contribute to the recent experience of natural resource degradation and domestication of land (Steffen *et al.,* 2015; COP26, 21). Greater Mahale Ecosystem (GME) faces a higher rate of 10% forest loss than the average Tanzanian 6% (William, 2018). Greater Mahale Ecosystem lost 1 million acres of forest (29% of forest cover) in the last 30+ years (Kaijage, 2016). The Greater Mahale Ecosystem Forest loss and land degradation cause loss of critical habitat for endangered biodiversity such as chimpanzees (Piel *et al.,* 2013). This ecosystem degradation trend threatens the disappearance of endangered wildlife and halt the opportunity to increase GDP through tourism and resource utilization. To halt forest and wildlife loss and the land domestication trend, Tanzania set aside 32.5% of her land as reserve lands (NESR, 2017). This achievement exceeds the 17% proposed by the Aichi target and the 30 by 30 goals (IUCN, 2017; NESR, 2017). The land reserved for conservation is more significant than the 20% of land used for agriculture; therefore, it should substantially address community economic benefit (NESR, 2017). However, the reserved lands do not guide land conversion and domestication in the village or community lands.

2.0 LITERATURE REVIEW

Studies on communal natural resources management through community-based natural resources management (CBNRM) revealed that most community-based natural resources management has weak governance and does not practice equity (Child & Barnes, 2010; Galvin*et al.*, 2018). Most of them have favoritism, and there is no fairness in resources utilization. Even though community-based natural resources management (CBNRM) is the most widely accepted contemporary communal natural resources management, it is questioned on sustainability and benefit equity (Child & Barnes, 2010; Muyengwa& Child, 2017). The study of Child & Barnes (2010), that concur with Muyengwa & Child (2017) conclusion, is in line with Cavendish & Campbell (2005) study findings on rural poverty, environmental inequality, and income in Zimbabwe. Cavendish & Campbell (2005) concluded that where community-based conservation is weak there is no equity. In Greater Mahale Ecosystem, communal-indigenous forest and wildlife management is practiced through village natural resource committees (TAWIRI, 2018). However, Nkonya *et al.* (2008), Mosimane & Silva (2015), Davis *et al.* (2019) and Tchakatumba *et al.* (2019) studies on natural resources management have a different conclusion. Nkonya *et al.* (2008) studied natural resources management and the economy in Uganda. Additionally, Davis *et al.* (2019) conducted a conservation institution review on community based natural resources management (CBNRM) in Zambia, while Mosimane & Silva (2015) conducted a community-based natural resources management (CBNRM) and community benefit sharing study in Namibia. Whereas Tchakatumba *et al.* (2019) conducted a study on Zimbabwe community based natural resources management (CAMPFIRE) on whether community wildlife management ensure household economic benefit. Both studies concluded that when local communities are benefiting from natural resources, there is both increase in economic welfare and compliance to natural resource management. However, the mentioned studies stressed on management equity and less on economic benefit equity. For that reason of less study on communal natural resources management practise contribution to community economic benefit, this research was carried in Greater Mahale Ecosystem.

The study of communal non-consumptive natural resources conservation practise contribution to community economy was carried in Greater Mahale Ecosystem (GME) part of western Tanzania ecoregion (Joh *et al,* 2019). The study adopted communal–indigenous natural resources conservation definition of "Governance by indigenous people and local communities" (IUCN, 2017; WCPA, 2019). Furthermore, terrestrial natural resources (forest and wildlife) were the focus of the study because they are the ones highly affected by degradation, domestication, and conversion of land (Piel *et al,* 2013; Steffen *et al.,* 2015; William, 2018). The study had a specific objective to examine the contribution of communal-indigenous non-consumptive natural resources conservation practice on community economic benefit (CEB) in the Greater

Mahale Ecosystem at western Tanzania. Thereafter, a research specific null hypothesis (H_2) was developed. The null hypothesis stated that H_2: Communal-indigenous non-consumptive terrestrial natural resources management approach does not have a statistically significant impact on community economic benefit.

3.0 MATERIALS AND METHODS

3.1 The Study Area

The study was conducted at the Greater Mahale Ecosystem (GME) in Western Tanzania, which is in Kigoma and Katavi regions. The area is a landscape that covers 18,200 km2 sited at Latitude 50.30' - 6^0.29' South and Longitude 29^0.43' - 30^0.37' East (Coulter, 1994). The area is bordered by natural features such as rivers, lakes and mountains as seen in Fig.1 below. To the West, is ancient second deepest lake in the world, Lake Tanganyika. To the North is Malagarasi River, to the heart and South is undulating Mahale Mountains. While Ugalla River form the Western border (TAWIRI, 2018).

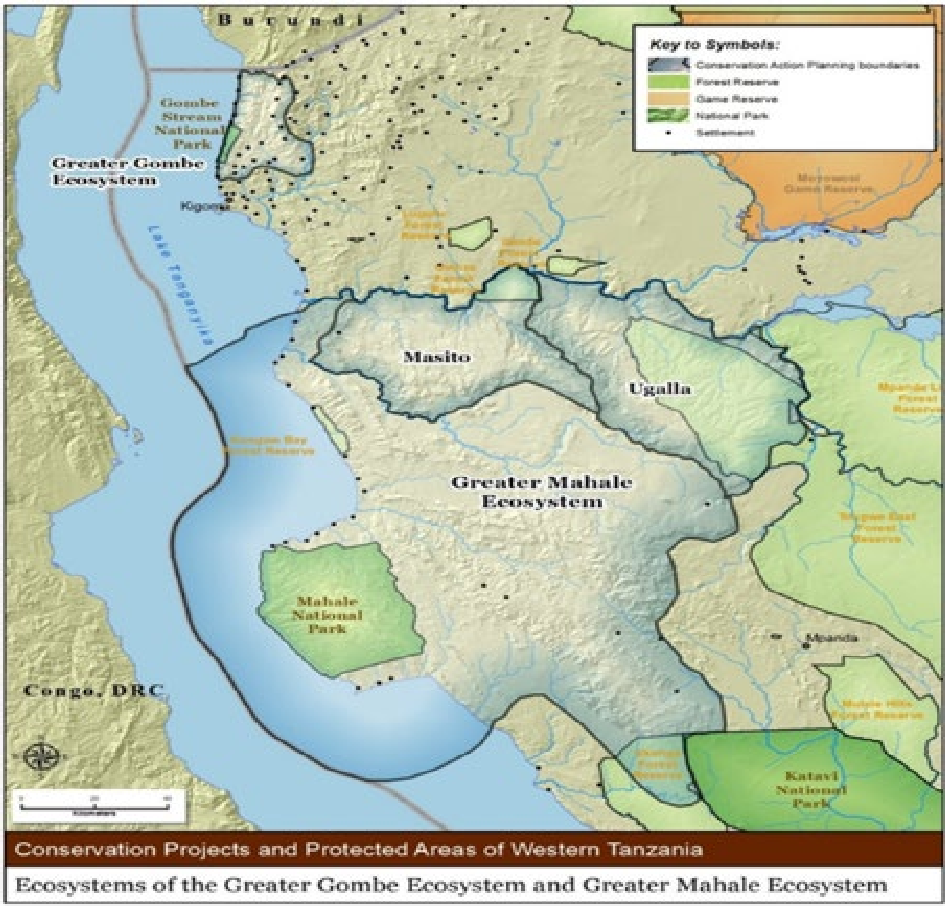

Figure 8: Map of Greater Mahale Ecosystem

Note: Adopted from CAP 2011

The water resources here hold about 17% of world surface freshwater (Coulter, 1994). The region has a unimodal long rain season starting from November to April, and a dry season starting from May to October (CAP, 2011; TAWIRI, 2018). The Greater Mahale Ecosystem topography starts with sharp features of Albertine Rift valley from Lake Tanganyika and undulating Mahale mountains (Coulter, 1994). The area is found on Zambezian woodland ecoregions. The area has open, drier, savanna and mosaic Zambezian woodlands. Corridor forest, wooded grasslands, and spacious zones of bamboo woodlands cover the ecosystem (Coulter, 1994). Moreover, the region has large lands of intact woodland characterized by *Brachystegia* spp. and *Julbernardia* spp. (TAWIRI, 2018). These long unimodal rainfall, variation of vegetation resources, topographical feature and the Albertine Rift valley made the area to be rich in biodiversity, which is one among 34 World Biodiversity hotspot (TAWIRI, 2018). Such verities of wildlife include 93% of endangered most eastern chimpanzee, white colobus monkey, zebras and savanna elephant (Piel *et al.,* 2013; TAWIRI, 2018). This is the only area in the world where chimpanzee habitat overlaps with savanna elephant habitat (TAWIRI, 2018).

More than half a million people live in Greater Mahale Ecosystem (GME). Native tribes include, Bembe, Fipa, Pimbwe, Konongo and Tongwe with poor performing economic welfare of less than 150 USD per year per household (URT, 2012; Leisher & Hess, 2017; Hardee *et al.,* 2018). Main social-economic activities heavily depend on natural resources utilization including fishing, farming, grazing and forest production (Hardee *et al.,* 2018; Leisher & Hess, 2017). The fast-increasing population and the heavy dependency on natural resources exert pressure on natural resource utilization.

3.2 Research Design and Implementation

The research adopted and applied constructivist philosophy that combined empirical, expertise and positivist approaches. Choice of that philosophy led to positivism approach of survey in line with Novikov& Novikov (2013). Adoption of that philosophy based on research believe grounds that reality is stable, fixed, can be observed, and can be applied in a similar environment. The study also applied interpretivism of reviews on expert knowledge and conducted studies. Combination of the approaches has been used to avoid methodological monism of using one approach which improved research quality (Gravetter & Forzano, 2012). An economic benefit model of the communal-indigenous non-consumptive natural resources conservation practice effect was developed.

Four-point numerical scaled survey questionnaire applied to 400 respondents and Key Informant Interview (KII) guide used to interview 40 respondents. Interviewed villages were 10 around Greater Mahale Ecosystem. Studied villages were Mwese, Lwega, Lugonesi, Buhingu, Mgambo, Katumbi, Nkokwa, Kaseganyama, Kasangantongwe, and Kasekese.

3.2.1 Community Economic Benefit Model

Contribution of communal-indigenous non-consumptive natural resources conservation practice on community economic benefit (CEB) in Greater Mahale Ecosystem at western Tanzania was examined. To assess magnitude of effect of the practice, a specific null hypothesis (H_2) was developed. H_2: Communal-indigenous non-consumptive terrestrial natural resources management approach does not have statistically significant impact on community economic benefit was tested.

Community economy benefit (CEB) is defined as a total of economic gains and value (EV) and is the function (*f*) of natural resources management approach (NRM). The mathematical statement can be summarized as follows: -

$$CEB = \sum(EV) \text{ and } CEB = f(NRM) \quad \ldots\ldots (1)$$

Whereby natural resources management approach (NRM) is the summation of resources utilization (RU) and natural resource controls and development (CD), then: -

$$NRM = \sum(RU, CD) \quad \ldots\ldots (2)$$

By substituting NRM by using RU from equation 2 into equation 1, then it is true that community economy benefit (CEB) is a function (*f*) of resources utilization (RU).

$$CEB = f(RU) \quad \ldots\ldots (3)$$

Given that resources utilization (RU) is composite of communal consumptive (CCT), communal non-consumptive (CNC) government consumptive (GCT) and government non-consumptive (GNC) resources utilization, therefore, it is true that: -

$$RU = \sum(CCT, CNC, GCT, GNC) \quad \ldots\ldots (4)$$

By reading and replacing second RU composites (CNC) found in equation 4 to equation 3, the following fifth equation will be produced: -

$$CEB = f(CNC) \quad \ldots\ldots (5)$$

Whereby, communal non-consumptive natural resources management (CNC) is built up of the following composites, tourism photographing and game viewing (PGC), grazing in communal managed natural resources areas (GZC), recreation benefit (RCC), transportation development (TPC), infrastructure's development (IFC), hotel services (HSC), spiritual and ritual benefits (SPC), and scientific studies (SCC). therefore equation 5 can be lengthened as:

$CEB = f\ (PGC, GZC, RCC, TPC, IFC, HSC, SPC, CSC)$ ……………………. (6)

Equation 6 composites are in a form of $X_1, X_2, X_3 ......X_t$. This form of equation allows to calculate a constant regression term as $\beta_0, \beta_1, \beta_2, \beta_3 .... \beta_t$, and β_0 = regression coefficient be developed. Then when random error term of ε is applied, equation (6) can be re written as follows:

$CEB = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + ... + \beta_t X_t + \varepsilon i$ ……………………………. (7)

And therefore, equation 7 can be re-written as follows: -

$CEB = \beta_0 + \beta_1 PGC + \beta_2 GZC + \beta_3 RCC + \beta_4 TPC + \beta_5 IFC + \beta_6 HSC + \beta_7 SPC + \beta_8 CSC + ...\varepsilon i$ ………………………………………………………………………. (8).

Equation (8) is the model of communal-indigenous non-consumptive natural resources conservation practice (CNC) – community economic benefit (CEB) in this study.

3.2.2 Sample Size

Sample size determined through Stevens (1996) sample size (N) formular of 50 =8m whereby m is the largest independent variable. Stevens (1996) minimum sample size calculation was adopted because it is a suitable method of calculating sample size when the study has many independent variables. The study had 19 independent variables (m). Independent variables were resources control and development (5), consumptive utilization (6) and non-consumptive utilization (8). Substituting m=19 in Stevens (1996) equation, will produce minimum sample size (N) = 50 + (8 X 19) =202. Even though the minimum sample size could have been 202, the study chose to have a bigger than 200 that is 400 respondents.

3.3 Data Analysis

Quantitative analysis method used to analyze quantitative data in SPSS. Excel framing summarizing method used to analyze qualitative data. Qualitative information triangulated and complemented quantitative data. Descriptive statistics was employed in the presentation of the results.

4.0 RESULTS AND DISCUSSION

4.1 Contribution of Communal-Indigenous Non-Consumptive Natural Resources Conservation Practice on Community Economy

Communal-indigenous non-consumptive natural resources management practice is applied in villages around Greater Mahale Ecosystem. The approach includes tourism photographing, recreation, hotel service, spiritual-ritual and scientific studies, and it had positive contribution on community economy. The communal-indigenous natural resources non-consumptive utilization contribution calculated mean shown in Table 1 was 46.99. The studied mean was almost equal to the average mean of 47 (Table 1). This result proposes that communal-indigenous non-consumptive natural resources management produces an almost strong although weak contribution on community economic benefit.

Table 1: Communal-indigenous non-consumptive natural resources management variables

Variable-composites	Calculated mean	Std. Deviation	N	Estimated average mean
Communal non-consumptive	46.99	11.797	728	47
Tourism photographing	6.53	2.655	728	7
Grazing	8.26	2.271	728	7
Recreation	6.64	1.716	728	5
Transportation	3.40	1.398	728	3
Infrastructure's	7.08	1.613	728	5
Hotel Services	7.02	2.369	728	7
Spiritual and ritual	4.25	1.810	728	3
Scientific studies	3.81	1.377	728	3

Note: N=728

Among the challenges that cause the weak contribution of communal non-consumptive natural resources conservation practice on the community economy were mentioned in interviews to be remoteness and poor road infrastructures. Grazing was among the strong noted variables that contribute community economy (Table 1). Key informant interview respondents when asked about the impacts of community non-extractive benefits of natural resources management had positive feelings on grazing economic benefit and reservation on remoteness and poor roads. For example, one famous interviewed agropastoralist who is also doing traditional healing in one of the villages said:

> *"We benefit a lot from grazing and accessing pastures for our livestock", and "we also conduct some worship". "However, even though we have good forests and peculiar wildlife such as chimpanzee, we do not receive tourists, may be because we are remote, and our roads are very bad".*

4.2 Photographic Tourism and Recreation in Communal Conserved Forests and Wildlife Area

Photographing and game viewing tourism in community-managed forests and wildlife areas such as wildlife corridors and dispersal areas had a calculated mean of 6.53 (Table 1). The calculated mean was just below average mean of 7 (Table 1). The finding signified a weak composite to explain weak community economic benefit. Analyzed data showed that 68% of respondents strongly disagreed that tourists visit community forests and wildlife areas (Figure 2). Some interviewed people pointed out underdeveloped tourism attraction sites as a reason that cause few tourists to visit Greater Mahale Ecosystem. One young man who is also doing forest patrol in one of the villages, when asked about community economic benefits gained through tourists' visit to community forests and wildlife areas said:

> *"Our community have many tourist attracting sites such as Nkonde waterfalls, (Figure 2) however are less developed, there are neither steps, latrines nor tents at site" how can tourist come to such areas? He questioned.*

However, the researcher had a physical visit to Nkondwe waterfall and found out that there are few tents at the site, but there were no steps, and the road was poorly developed. This result suggests that there are less developed systems that benefit the community economy from non-consumptive resource utilization. Therefore, less developed systems and capacity are part of weak management capacity. The finding is in line with Muyengwa and Child (2017), who said that when and where there is less community management capacity, there is less equity and less economic gain.

Whereas recreation's impact on community economics was 6.64 (Table 1) above the average mean of 5 (Table 1). Recreation was connected to looking at nature's beauty, which does not cost money. Looking at the beauty of nature did not have excludability in utilization and, therefore, does not create income. One young woman who was born and lived in the highlands of the area, when asked about the recreational value of nature, said:

> *"Hiiiiii, I do not go to forest for recreation, although we sometimes enjoy looking at our forests and hills. I go to town to enjoy life if I have money. We conduct party and ceremonies in halls and not in forest".*

The information showed Greater Mahale Ecosystem have weak ecological management produced integrated conservation economic benefit. Economic welfare is improved when ecosystem conservation and ecological benefit are integrated (Andika, 2020). Such integrated management of nature includes enjoying the beauty of nature and ecotourism.

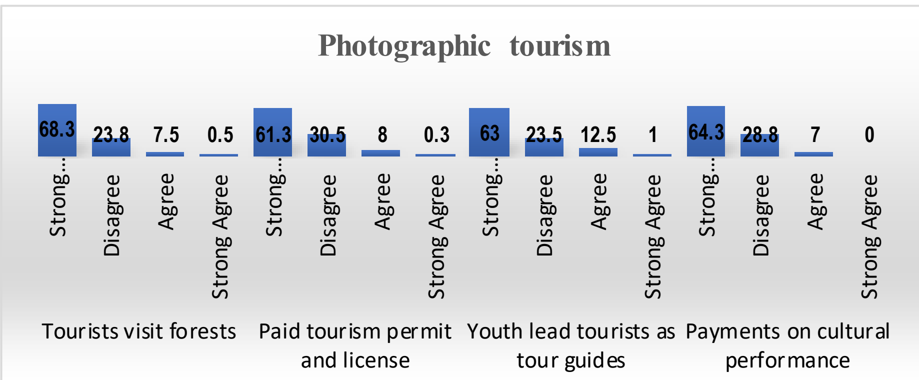

Figure 2: Photographic tourism in communal-indigenous conserved areas

4.3 Grazing and Livestock Keeping in Communal Managed Forests and Wildlife Areas

Community around Greater Mahale Ecosystem practice grazing and livestock keeping in communal managed forest and wildlife areas such as wildlife corridors and wildlife dispersal areas. Grazing and livestock keeping computed impact on community economy mean was 8.26 (Table 1) above average mean of 7 (Table 1). Accessing grazing pastures in communal forests and wildlife areas was important and impactful to the agropastoral community. Even though the majority (58%) of respondents (Figure 3) agreed to have enough water for their livestock, there was strong concern about access to pastures and markets. Only 29% of respondents agreed to have enough pasture and only 21.8% of respondents agreed to have a good price for livestock (Figure 3). Interview with community confirmed un accessibility of pastures in communal forests and wildlife areas. One elderly agropastoral whose grandfather came to Greater Mahale Ecosystem, when asked on livestock keeping and access to pastures, he said:

> *"Even though our area is remote, we do not access pastures in communal forest. We graze our livestock in our own land. However, people from central Tanzania come with their livestock and graze in forest. Unfortunately, when are caught by forest patrols, they pay huge fines".*

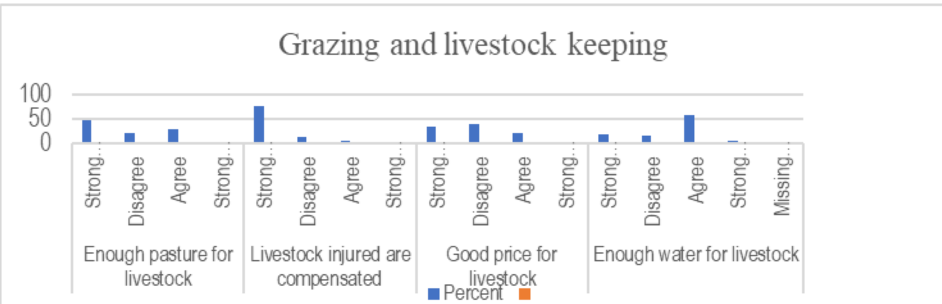

Figure 3: Grazing and livestock keeping in communal-indigenous conserved areas

4.4 Access to Transport and Infrastructure Development in Conserved Communal Forests and Wildlife-Managed Areas

The contribution of infrastructure development and access to transport services were studied and found to be less developed in communal managed forest and wildlife areas in Greater Mahale Ecosystem. The contribution of transportation services to the community economy computed mean was 3.4 (Table 1), slightly above the average mean of 3 (Table 1). Even though this mean is above expected, there was substantial concern on whether companies pay transport fees and access of vehicles to town. Such concern implied the existence of less community economic benefit. That concern is shown in Figure 4, where 90% of respondents disagreed that companies pay transportation fees, and 92% of respondents disagreed with accessing vehicles to town. Transport access is linked with road infrastructure development.

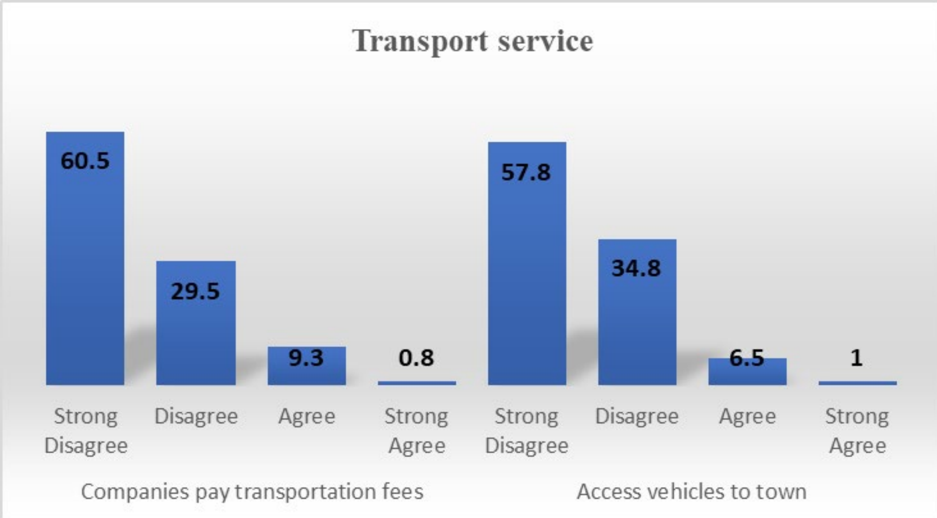

Figure 4: Transport service in communal-indigenous conserved areas

Infrastructure development that includes road, hotels, schools, and health centers found to impact community economy. The infrastructure development impact calculated mean was 7.08 (Table 1) above average mean of 5 (Table 1). Even though the mean looks good and stronger, there was concern that road infrastructures were poor and that the well-developed infrastructures are health and school structures. Most (93%) of respondents strongly disagreed on whether there is road construction or rehabilitation, but more than 75% of respondents also agreed on health facilities and classrooms constructions (Figure 5). Not only road infrastructures were noted to be less developed, but also hotel infrastructures as well.

Hotel service in communal forests and wildlife areas in Greater Mahale Ecosystem conservation contribution on community economy was accessed. Contribution of hotel services mean was 7.02 (Table 1) which was almost equal to the average mean of 7 (Table 1). The finding suggests almost a strong mean. However, interviewed people had a different opinion on hotel services. One interviewed elderly woman who has small vegetable business interviewed whether they sell products or be employed in communal forests hotels, she said:

> *"I lived here for long time, but I had never seen a hotel in our village forests, there is no hotels therefore, I do not sell vegetables to hotels in forest. And how can you be employed to the hotel that is not existing? And who is going to build a hotel while there are no tourists? There is no employment from the hotels because they do not exist".*

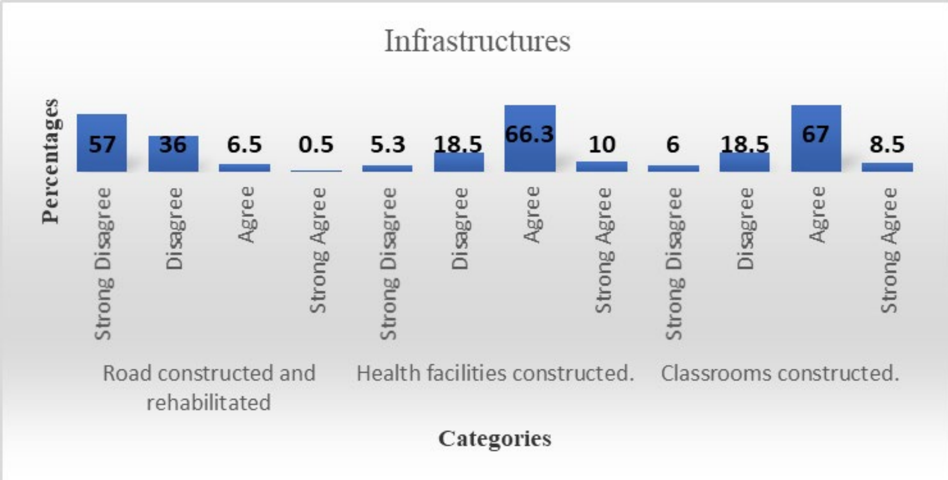

Figure 5: Infrastructures in communal-indigenous conserved areas

4.5 Spiritual and scientific non-consumptive benefits

Spiritual, ritual, academic and scientific gained access contribution to community economic benefit in the Greater Mahale Ecosystem were studied. Spiritual and ritual contribution computed mean was 4.25 (Table 1). This was a strongest mean against the average mean of 3 (Table 1). The data implies that there were intrinsic conservation values attached with beliefs and taboos. Such intrinsic values were affirmed by interviewed people. One interviewed respondent who is a Tongwe tribe and came from Tongwe chiefdom when asked on spiritual and ritual benefit of conservation, he said:

> *"There are financial and leadership mysterious powers coming from the forests. There was a big magic snake that provides blessings and leadership powers lived in our forest near the Kalolwa airstrip. After increased settlement and development the snake moved to Mahale National Park Forest. Elders conduct spiritual and ritual events in that forest, and the magical power comes".*

Whereas contribution of scientific and education in community conserved natural resources practice mean was 3.81(Table 1) against average mean of 3 (Table 1). The scientific benefit is associated with small token paid by researchers when they recruit research assistant and data collectors from the community. The information was affirmed during the interview. One young man who participated as data collectors for measuring planted trees survival rate, when asked on scientific benefits from conservation of communal forests and community wildlife areas, he said:

> *"When you are lucky to be recruited as a data collector, researchers pay some money even though they pay small amount. Students from Universities visit our forests and wildlife corridors for learning. They recruit us as data collectors and pay us when we assist them in data collection. Even though that is a temporal employment it matters a lot".*

4.6 Testing of Null hypothesis

The study conducted a Model fit test and test on Null hypothesis (H_2) test. The Null hypothesis stated H_2: Communal-indigenous non-consumptive terrestrial natural resources management approach does not have a statistically significant impact on community economic benefit. Multiple linear regression techniques carried to test the study-specific null hypothesis (H_2).

Correlation model fit test between communal-indigenous non-consumptive natural resources conservation (CNC) to community economic benefit (CEB) was calculated. Adjusted R Square of 0.46 was realized. The R Square is 46% explicated variation in community economic benefit that is explained by the inclusion of communal-indigenous non-consumptive utilization. The model has poor R2 of 0.46 and therefore it has weak predictive ability (46%) as ranked by Almquist, Ashira & Brännström (2019) and Profillidis & Botzoris (2019). The result suggests weak predictivity ability of communal non-consumptive natural resources utilization impact on community economic benefit.

Linear correlation is calculated between communal-indigenous non-consumptive natural resources management (CNC) and community economic benefit (CEB). The Pearson (r) covariance statistical relationship correlation coefficient was calculated. Pearson -r (728) = .68, $p<.001$. The positive Pearson (r) above 0.6 and close to 0.7 shows that the relationship was good but not very strong correlated (Almquist, Ashira & Brännström, 2019; Profillidis & Botzoris,2019).

Multiple regression analysis was performed on the impact of communal non-consumptive natural resources management approach to community economic benefit (Table 2). Communal-indigenous resources management non-consumptive utilization approach and its composites that were tourism photographing and game viewing in communal area (PGC), grazing in communal managed natural resource areas (GZC), recreation benefit (RCC), transportation development (TPC), infrastructure's development (IFC), hotel services (HSC), spiritual and ritual benefits (SPC), and scientific studies (SCC) were analyzed.

Table 1: Multiple regression analysis for communal non-consumptive conservation practice on community economic benefit

Composites	B	95% CI	β	t	p	SE
Tourism Photographing	-1.724	-2.214, -1.234	-.194	-6.911	.000	.249
Grazing	.059	-.466, .584	.006	.222	.824	.267
Recreation	.263	-.368, .895	.019	.819	.413	.322
Transportation development	1.079	.219, 1.939	.065	2.463	.014	.438
Infrastructure's development	1.147	.622, 1.672	.079	4.287	.000	.268
Hotel Services	-.789	-1.306, -.273	-.080	-3.003	.003	.263
Spiritual and ritual	2.116	1.224, 3.008	.126	4.657	.000	.454
Scientific studies	-1.202	-1.835, -.570	-.093	-3.734	.000	.322
Communal non-consumptive	1.335	1.230, 1.440	.680	24.985	.000	.053

Note. CI = Confidence Interval for B, SE = Standard Error, p=0.000

It was interesting to note that utilizing natural resources in communal forests and wildlife through tourism photographing, hotel services and scientific studies would negatively impact community economic benefit as per regression coefficient (B) of those composites (Table 2). Utilizing natural resources through communal tourism photographing had the highest negative impact on community economic benefit by having regression coefficient B= -1.72 at 95% at confidence interval (CI) = -2.21, -1.23; p=0.000. This means an increase in one unit of communal tourism photographing utilization in communal forests and wildlife areas will decrease community economic benefit (CEB) by 1.72 (172%). Because p<5% and confidence interval (CI) does not include null value (x=0), it is statistically significant at the 5 % level. This finding aligns with interviewed community perception (section 3.2) who showed that setting aside their forests and wildlife areas will negatively impact their community economic benefit.

It was also found out that spiritual and ritual utilization of natural resources in communal forests and wildlife areas had the highest community economic benefit (Table 2). Multiple regression analysis for contribution of spiritual and ritual access of wildlife areas and forests showed regression coefficient B= 2.12 at 95% at confidence interval (CI) = 1.22, 3.01; p=0.000. This implied that increase in one unit of spiritual and ritual utilization of forests and wildlife area, community economic benefit (CEB) increases by 2.12 (212%). Because p<5% and confidence interval (CI) does not include null value (x=0), it is statistically significant at the 5 % level. This finding is supported by interviewed community quoted in section 3.5 who perceive to receive magical powers from communal forests and wildlife areas.

The multiple regression analysis result for impact of communal-indigenous non-consumptive natural resources utilization on community economic benefit presented in Table 2. The result showed that regression coefficient B= 1.34 at 95% at confidence interval (CI) = 1.23, 1.44; p=0.000. This finding implies that increase in one unit of communal non-consumptive utilization, community economic benefit (CEB) increases by 1.34 (134%). Because p<5% and confidence interval (CI) does not include null value (x=0), it is statistically significant at the 5 % level. The above findings of regression coefficient B= 1.34 at 95% at confidence interval (CI) = 1.23, 1.44; p=0.000 were sufficient statistical evidence against null hypothesis (H_2). The null hypothesis (H_2) that stated communal-indigenous non-consumptive terrestrial natural resources management approach does not have a statistically significant impact on community economic benefit was rejected. Rejection of the null hypothesis was in favor of the alternative hypothesis. The result suggests that it could be true that communal-indigenous non-consumptive terrestrial natural resources management approach may have a statistically significant impact on community economic benefit.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The general conclusion of this study is that communal non-consumptive natural resources conservation practice has a significant impact on community economic benefit (CEB). Additionally, it was evidently found that remoteness and poor developed infrastructures such as roads has been a stumbling block in developing conservation economic benefit in Greater Mahale Ecosystem.

Western Tanzania tourist circuit connectivity such as road networks should be developed. This will benefit not only benefit communities around Greater Mahale Ecosystem but also country GDP.

Communal non-consumptive natural resources management approaches such as avoided deforestation, degradation and increased sequestration carbon credits should be emphasized and, whenever possible, should be linked in integrated ways with consumptive approaches to maximize conservation-economic gains.
Lastly, this study recommends undertaking natural resources valuation in Greater Mahale Ecosystem (GME) and possibly in whole Tanzania. Country realistic development plans will depend on understanding what resources the country own and how rich it is. Natural capital and country real wealth are its natural resources. That be said, Total Economic Valuation (TEV) is recommended for Tanzania.

REFERENCES

Almquist, Y. B., Ashir S., &Brännström, L. (2019). A guide to quantitative methods. Stockholm University, Sweden.

Andika, G. (2020). *Economic growth dynamics between resource-rich and resource-poor countries in sub-Saharan Africa*: The role of politics and institutions. African Development review Journal.

Arrow, K. B., Bolin, R., Constanza, P. Dasgupta, C., Folke, C.S., Holling, B.-O., Jansson, S., Levin, K.-G., Maler, C., Perrings, & Pimentel, D. (1995). *Economic growth, carrying capacity and the environment*. *Science* 268:520–521.

Bluwstein, J., Moyo, F. & Kicheleri, R. P. (2016). *Austere conservation: understanding conflicts over resource governance in Tanzanian wildlife management areas*. Conservation and Society,14(3), 218–231.

Cavendish, W. & Campbell, B. M. (2005). *Poverty, environmental income and rural inequality*: A case study from Zimbabwe

Child, B. & Barnes, G. (2010). *The conceptual evolution and practice of community-based natural resource management in southern Africa*: Past, present and future. *Environmental Conservation,37*(3), 283-295. doi:10.1017/S0376892910000512.

Conservation Action Plan report (CAP), (2011). *Conservation Action Plan for Western Tanzania*. The Nature Conservancy.

Convention on Biological Diversity (CBD). (2011). *Decision Adopted by the Conference of the Parties to the Convention on Biological Diversity at its Tenth Meeting [Decision X/2]*

Coulter, G.W. (1994). *Lake Tanganyika.*: Speciation in ancient lakes. Edited by Martens K., Goddeeris, B. and Coulter G. Archiv fur Hydrobiology 44: 13–18.

Davis, A. -L., Blomley, T., Homer, G., Sommerville, M. & Nelson, F. (2019). *Community-based natural resource management in Zambia*: A review of institutional reforms and lessons from the field. Maliasili, ILRG and The Nature Conservancy: Lusaka.

Galvin, K. A., Beeton, T. A. & Luizza, M. W. (2018). *African community-based conservation: A systematic review of social and ecological outcomes.* Ecology and Society, 23(3), 39. HTTPS:// doi.org/10.5751/ES-10217-230339.

Gravetter, F. J. &Forzano, L. B. (2012). *Research Methods for the Behavioral Sciences:* (4th ed.). Belmont, CA Wadsworth.

Gujarati, N. (2004). *Basic Econometrics*. Third Edition. McGraw-Hill Book Company, New York.

Hardee, K., Patterson, K.P., Schenck-Fontaine, A., Hess, S., Leisher, C., Mutunga, C., Margoluis, C. & Honzak, C. (2018). *Family planning and resilience:* Associations found in a Population, Health, and Environment (PHE) project in Western Tanzania. Population and Environment https://doi.org/10.1007/s11111-018-0310. CrossMark.

International Union for Conservation of Nature report (IUCN). (2017). *Governance of Protected and Conserved Areas in Tanzania*. Proceedings of the workshop.

John, J., Kohi, E., Park, J., Nkwabi, A., Choi, C., Warema, C., Hur, W., Kim, H., & Lee, J. (2019). *Birds of Western Tanzania*. National Institute of Biological Resources, Tanzania Wildlife Research Institute (TAWIRI). Printed in the Republic of Korea.

Kaijage, E. (2016). *Tanzania mapping REDD+ and Finance Flows 2009–2014:* Environment Division, Vice President's Office, United Republic of Tanzania.

Kerapeletswe, C. K. & Lovett, C. J. (2005). *The role of common-pool resource (CPR) in the economic welfare of rural household.* Environmental Department. University of York.

Leisher, C. & Hess, S. (2017). *Tuungane midterm review and evaluation. Tuungane Outcome analysis:* The Nature Conservancy and Pathfinder International.

Morrison, T. A., Link, W. A., Newmark, W. D., Foley, C. A. H. & Bolger, D. T. (2016). *Tarangire revisited: Consequences of declining connectivity in a tropical ungulate population.* Biological Conservation, 197, 53–60.

Mosimane, A. W. & Silva, J. A. (2015). *Local governance institutions, CBNRM, and benefit-sharing systems in Namibian conservancies*. Journal of Sustainable Development, 8(2), 99.

Murphree, M. W. (2009). The strategic pillars of communal natural resource management: benefit, empowerment and conservation. *Biodiversity Conservation* **18,** 2551–2562. https://doi.org/10.1007/s10531-009-9644-0. (Retrieved 12th May 2020).

Muyengwa, S. & Child, B. (2017). *Re-assertion of elite control in Masoka's wildlife program, Zimbabwe*. Journal of Sustainable Development, 10(6), 28. https://doi.org/10.5539/jsd.v10n6p2

National Environment Statistics Report (NESR). (2017). *Environmental statistics.* Dar es Salaam, Tanzania Mainland.

Nkonya, E., Pender, J., & Kato, E. (2008). *Who knows, who cares? The determinants of enactment, awareness, and compliance with community Natural Resource Management regulations in Uganda*. Environment and Development Economics, *13*(1), 79-101. doi:10.1017/S1355770X0700407X.

Novikov, A. M & Novikov, D. A. (2013). *Research Methodology; from Philosophy of Science to Research Design*. Volume 3, CRC Press, Taylor & Francis Group, Boca Raton.

Pailler S., Naidoo R., Burgess N.D., Freeman O.E. & Fisher B. (2015*). Impacts of Community-Based Natural Resource Management on Wealth, Food Security and Child Health in Tanzania*. PLoS ONE 10(7): e0133252. https://doi.org/10.1371/journal.pone.0133252.

Piel, A. K., Stewart, F. A., Pintea, L., Li Y., Ramirez, M. A. & Loy, D. E. (2013). *The Malagarasi River does not form an absolute barrier to chimpanzee movement in western Tanzania:* PLoS One, 8(3), e58965.

Profillidis, V.A. & Botzoris G.N. (2019). Modeling of Transport Demand. Analyzing, Calculating, and Forecasting Transport Demand. Copyright © 2019 Elsevier Inc. https://doi.org/10.1016/B978-0-12-811513-8.00005-4. Retrieved on 21 August 2021.

Ribot, J. C. (2003). *A Theory of Access:* Institutions and Governance Program. World Resources Institute. Department of Environmental Science, Policy and Management. Division of Society and Environment. University of California. 68(2), 2003, pp. 153–181. 2003 by the Rural Sociological Society.

Steffen W., Richardson, K., Rockström, J., Cornell, S. E., Fetzer, I., Bennett, E. M., Biggs, R., Carpenter, S. R., Vries, W. De, Wit, C. A. De, Folke, C., Gerten, D., Heinke, J., Mace, G. M., Persson, L. M., Ramanathan, V., Reyers, B. & Sörlin, S. (2015). *Planetary boundaries*: Guiding human development on a changing planet', *Science*, 347/6223: 1–10. DOI: 10.1126/science.1259855

Stevens, J. (1996). *Applied multivariate statistics for the social sciences*. Mahwah, NJ: Lawrence Erlbaum Associates.

Tanzania Wildlife Research Institute (TAWIRI). (2018). Tanzania Chimpanzee Conservation Action Plan 2018-2023 TAWIRI Contact: info@tawiri.or.tz

Tchakatumba, T. E., Gandiwa, E., Mwakiwa, B., Clegg & Nyasha, S. (2019). *Does the CAMPFIRE programme ensure economic benefits from wildlife to households in Zimbabwe*? Journal of Ecosystems and People, 15(1), 119–135.

Taylor, A. (2011). *Ecosystems, development, and climate adaptation*: Improving the knowledge base for policies, planning and management. Stockholm Environmental Institute. Oxford

UNEP-WCMC and IUCN. (2018). *The lag effect in the World Database on Protected Areas*: https://www.protectedplanet.net/.../the-lag-effect-in-the-world-databse-on-protected-a(retrieved10th March 2019).

United Nations Climate Change Conference - COP26 (2021). Glasgow Climate Change Conference. UNFCCC Process and meetings resolutions.https://www.un.org/en/climatechange/cop26

URT (The United Republic of Tanzania). (1998a). The Wildlife Policy of Tanzania. Dar es Salaam, Tanzania. Government printer.

URT (The United Republic of Tanzania). (1998b). The Forest Policy of Tanzania. Dar es Salaam, Tanzania. Government printer.

URT (Tanzania population and housing census). (2012). Government printer.

URT (Tanzania Wildlife Conservation Act). Wildlife Conservation Act (2009). (N0. 5 of 2009) of Tanzania, Dar es Salaam, Tanzania. Government printer.

William, A. (2018). *Lake Tanganyika basin and Greater Mahale Ecosystem, Tanzania 30-year forest loss*. TNC Report.

World Bank Report (2019). https://www.worldbank.org/en/region/afr/overview (Retrieved on 28th June 2019).