

The Moderating Effect of Rural Extension Services on Livelihood Choices in Kieni Semi Arid Area of Kieni, Kenya

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Abstract: Poverty, in the developing world, continues to cause livelihood challenges among rural populations. One of the discreet impacts of livelihood assets on livelihood choices is the moderating effect of rural extension services. Most studies regarding poverty reduction overlook the moderating effect of rural extension services on livelihood assets and livelihood choices. The purpose of this study was to investigate how extension services moderate household choices based on livelihood assets in Kieni East and West sub counties of Nyeri County. The study adopted cross sectional research design, involving mixed method approaches to collect data. Household survey was the main source of quantitative data collection, while the qualitative aspect of data was collected using semi structured interviews, participant observations, and desk reviews. Proportionate Stratified Random Sampling Technique was used to establish a 400 sample size in 10 sub locations. Data was analyzed using descriptive and econometric modeling techniques. Socioeconomic data was analyzed using statistical descriptive techniques, and independent T-Test was used to test statistical significance ($p < 0.05$) at the two sites. Data with quantifiable factors was subjected to hierarchical multiple regression analyses, while qualitative data was analyzed using grounded theory, discourse and narrative analyses. Results show that 19.8% of the respondents were visited by extension officers over the last three years, while 24.4% indicated to have actively participated in local extension programmes. While independently household assets [$b = .344, SE = .049, \beta = .317, p < .01$] and extension services [$b = .284, SE = .043, \beta = .297, p < .01$] had a significant effect on livelihood choices, results show the interaction of extension services and household livelihood assets ($Z * X$) had insignificant [$b = .074, SE = .048, \beta = .071, p > .001$] influence on household livelihood choices in the study area. The results of the study demonstrate that demand based extension services in the area have insignificant influence on livelihood choices by households, which in the long run affect negatively household wellbeing. The study concludes with some recommendations for policy consideration.

Keywords: Household, livelihood, livelihood assets, livelihood choices, rural agricultural extension, poverty, household wellbeing, semi-arid lands, rural areas, Kenya.

1. INTRODUCTION

In today's world, poverty is associated with the rural populations because they are generally deprived of both essential and economic livelihood opportunities. Current concerns about level of poverty in rural areas have caused significant interests in research. Three out of four poor people in developing countries live in rural areas, with the majority depending on agriculture for their livelihoods [1]. Therefore agriculture remains the main source of income for around 2.5 billion people in the developing world [2]. Strategies to improve living standards of populations in developing countries through rural development have been closely linked to evolution of development approaches. These approaches have been applied as policies for poverty reduction with models like sustainable livelihoods, small farm development, integrated rural development, market liberalization, participatory development, and human development taking centre stage. Other examples are community development, poverty reduction strategies, food security programmes, sustainable agriculture

and rural development, and since the year 2000, the Millennium Development Goals (MDGs) [3] and from 2015, the sustainable development goals [4]. However, poverty remains a significant issue despite these efforts. Evidence by [5] shows there are still millions of people worldwide who are living in chronic poverty in spite of progress made in the achievement of MDGs.

Over the years, promotion of rural livelihoods to alleviate poverty by rural development agencies in the developing world concentrated on simple approaches of embracing sustainable livelihoods by rural households. Accordingly, a lot has been learnt about poverty reduction and environmental conservation in the last decade (2008-2018) in terms of the relationship between poverty and environmental degradation. Regardless of advances in the development and promotion of sustainable development, rural households' motivation to take up new sustainable livelihoods, particularly among the traditional rural households has remained insignificant. This has led to the realization that livelihood adoption is not only a technical problem but also a socioeconomic problem, which in recent times, has directed attention to the influence of livelihood assets in rural household livelihood choices. The body of literature on households' livelihood decisions highlights the complexity of factors involved in the interactive role. The intricacy arises from the variety of circumstances under which rural households function. It is generally recognized in literature that a number of factors explain the differences in household livelihood choices by rural households. However, the specific socio-economic and institutional variables affecting the decisions, differ across countries, regions, villages, and households.

Livelihood authors strongly support the idea of livelihood activities as sources of household means of survival. [6], for instance, underlines that livelihood activities are depended on assets access and determine the living gained by the rural households. Like in most contemporary developing countries, the fundamental characteristic of rural households in Kenya is their ability to adapt in order to survive, through rural livelihoods variation. In this last instance, as [7] stressed, "rural livelihoods diversification is a survival strategy in which factors of both threat and opportunity cause the rural household to adapt intricate and diverse livelihood strategies in order to survive". While participation in multiple activities by rural households is not new, there was relative neglect of diverse dimensions of rural livelihoods other than access to farming until mid-1980s. The dominant strategy for improving rural welfare was then small farm output growth. Hence the extent of diversification away from agriculture is a sign of the degree to which farming operations only cannot provide a secure and improved livelihood.

Some would argue that livelihood diversification is panacea to poverty reduction especially in the developing world. A study by [1] showed that poverty reduction in sub-Saharan Africa might be achieved through livelihood diversification in rural areas. Therefore, consistent with this pronouncement, rural households have four possible options to choose livelihoods for their wellbeing. They practice farming, raise livestock, and engage in small businesses. The last option is not attractive, at least for poor households. It is the access to common forest resources when the need to survive arises. As an active social process, livelihood diversification involves the maintenance and continuous adaptation of diverse portfolio of activities over time in order to secure survival and improve living standards [8]. However, livelihood diversification has causes and consequences for the rural communities. Therefore, the overall process of structural transformation impacts on the use of resources and the environment in general [9]. Since the environment is a critical input for rural households, environmental degradation in turn infers a shrinking input foundation for the poor households that increase harshness of poverty.

To safeguard the negative impact of livelihood diversification so as to promote sustainable livelihood practices, [10] argues that integration of subsistence orientated smallholder farming into the market economy is an important consideration for rural development policy makers and researchers. A common argument in this direction is that in order to produce marketable surpluses and sustain food security, rural smallholders need not only access to agricultural technologies, but also private assets (e.g. land, equipment, etc.) and public goods [10]. According to [11], there is compelling evidence that agricultural extension services as a public good has significant impact on farm productivity. This assertion was investigated further by [12] who studied the impact of agricultural extension and roads on poverty in Ethiopia. Results suggest that the impact of access to agricultural extension by rural households on poverty reduction was greater than the impact of access to infrastructure. Besides, investment in agricultural extension has been shown to increase returns in both developing and developed countries [11]; [13]. Extension services have therefore come in to serve as opportunities to support the rural populations to improve their living standards by addressing the challenges of rural livelihoods. It is also widely acknowledged that appraisal of extension impact on rural livelihoods is challenging in terms of dealing with attribution issues and linking cause and effect quantitatively [14]. Although the use of Sustainable

Livelihood Approach [6]; [3]; [15]; [16] to investigate the impact of extension services on rural livelihoods might fill in the gap of this challenge, it is not common practice in many developing countries including Kenya. Similarly, while there is a large literature dealing with issues related to agricultural extension in developing countries, rigorous impact evaluations of this kind are not common [17].

The battle against poverty remains an important priority on Kenya's development agenda as articulated in Vision 2030[18]. The Vision aims to make Kenya a "middle" income country providing high quality life for Kenyans by the year 2030. However, the majority of the poor and food insecure groups continue to be concentrated in rural areas, where their livelihoods [19] depend on subsistence agriculture. The purpose of this study is to determine the influence of rural extension services on household livelihood choices in Kiambu East and West Sub counties so that rural development programmes objective to improve household welfare and prevent environmental degradation prompted by livelihood pressures can be achieved.

2. LITERATURE REVIEW

A. *The Basics of Livelihood Approaches*

Livelihood approaches recognise that household resources are at the centre of livelihood choices. Resources are seen in terms of 'capitals' and which are viewed as accessible or inaccessible to people mainly on the basis of structural factors. Approaches like these focus on sustainable livelihoods, which were developed by DFID in the 1990s [20]; [21]. Livelihood studies in the past have come to the fore in response to the limited success of poverty studies [22]; [23]. Poverty studies have also come to be seen as too engrossed on the powerlessness of poor people, and therefore livelihood approaches [24] enrich poverty studies by starting its analysis with the creative choices of people in making a living. The approach therefore changes from a focus on what poor people lack to analysis of how they manage to survive.

Livelihood approaches view resources as assets and categorise them into five categories: human, physical, financial, natural and social [25]; and [26], [27]. To investigate the behaviour of rural households in their attempt to improve their welfare, the rural household approach is most applicable since it requires information on household members. Definitional concepts of livelihoods vary among researchers. [28] define livelihood as 'comprising the capabilities, assets, and activities required for means of living' focusing directly to the links between assets and options households possess in pursuit of alternative activities that can generate the income level required for survival. On the other hand, [7] and [29] portray a common and related understanding on this. The authors define a livelihood as comprising the assets, the activities, and the access to assets and activities as mediated by social capital which together determine the living gained by the rural individual or household. Therefore authors identify assets, mediating processes, trends and shocks, and activities as the critical components and processes that jointly contribute to rural livelihood choices. Thus, the rural livelihoods approach is essentially a micro policy analysis framework in which the assets or resources are the activity components that improve livelihoods. Consequently, household assets are viewed as a basket of goods whose availability and access is directly related to the environment in which they occur.

B. *Rural extension services and household livelihood choices*

Rural Extension Services

Rural agricultural extension services play an important role in agricultural development and can contribute to improving the welfare of farmers and other people living in rural areas. [30] defines agricultural extension services as "the entire set of organisations that support and facilitate people engaged in agricultural production to solve problems and to obtain information, skills and technologies to improve their livelihoods". Extension service can thus contribute to the reduction of the productivity discrepancy by increasing the speed of technology transfer and farmers' knowledge and assisting them in improving farm management practices [11]; [31]; [30]. Additionally, extension services play an important role in improving the information flow from rural households to researchers [11]. In apparent concurrence, [32] define the term extension as *the conscious use of communication of information to help people form sound opinions and make good decisions*. As a system, adds [33], extension facilitates the access of farmers, their organizations and other market actors to knowledge, information and technologies; facilitates their interaction with partners in research, education, agribusiness, and other relevant institutions; and assists them to develop their own technical, organizational and managerial skills and practices.

A range of approaches to extension delivery have been promoted over the years. Early models focusing on transfer of technology using a 'top-down' linear approach were criticised due to the passive role apportioned to farmers, as well as the failure to factor in the diversity of the socio-economic and institutional environments facing farmers and ultimately in generating behaviour change [34]; [35]. A number of models have been implemented since the 1970s, combining approaches to outreach services and adult education, including the World Bank's Training and Visit (T&V) model [36], participatory approaches [37], and most recently farmer field schools (FFSs) [38]. Additional extension modalities include ICT-based delivery which provides advice to farmers on-line and other approaches such as the promotion of model farms [34].

Since the 1980s, the approach to extension service delivery has drawn increasingly on more participatory methods. The main objective of participatory approaches to agricultural extension is to empower rural households where the role of extensionists shifts from 'teachers' to 'facilitators' in this process. Unfortunately, evidence assessing impact of such methods seems limited at best, but initial searches identified an evaluation of a participatory group extension approach in Egypt [39]. In the past, extension services were taken to the rural households, especially smallholder farmers, whether in groups or individually through the training-and-visit approach; but in recent times, and with the new agricultural policies, extension services are provided to farmers only upon request, using a demand-driven approach. The demand-driven approach assumes that farmers who are eager for agricultural advice will ask for it, unlike the training-and-visit approach that imposes learning on the farmers without them seeing the need for it [40].

Impact of extension programs on household livelihoods

While there is a large literature dealing with issues related to agricultural extension in developing countries, rigorous impact evaluations of agricultural extension interventions are not common. This is partly due to the complexity of evaluating such interventions in the face of the wide range of additional factors that influence agricultural outcomes. These factors include agro-ecological climate, weather events, availability and prices of inputs, market access, farmers' characteristics, and so on. In addition, biases inherent in attributing the impact of extension services on agricultural production mean that measured effects might result from pre-existing differences rather than the programme under evaluation [41]. [42] highlight three common types of bias. Endogenous placement bias might occur where programmes are situated in areas seen as more likely to be receptive to extension services. Selection bias occurs where skilled and knowledgeable farmers are more likely to seek out extension services and, although this source of bias may be reduced if extension agents initiate contact with the farmers, agents themselves may also rather work with more experienced farmers. Simultaneity bias arises in the sample of farmers visited by extension services if farmers only contact extension agents when they have problems. These biases are well known, but nevertheless, the analyses used in most evaluations do not allow for their control.

Nonetheless, evaluations and meta-evaluations have been conducted, as summarised in a number of literature reviews [30]; [37]; [14]; [43]; [44]; [11] and one meta-analysis [45]. Most of these studies draw on data that were not collected to high quality standards of impact evaluation, i.e. utilising experimental or quasi-experimental design in attributing the impact of extension services on outcomes of interest. [44] assessed the impact of World Bank support to the development of national research and extension systems in the 1980s and 1990s. The study concluded that, despite serious limitations in the systems receiving support, there have been significant positive effects of World Bank interventions. However, this is also based on a review of project completion reports rather than impact evaluative evidence.

In relation to its role in rural livelihoods, agricultural extension encompasses the entire set of organizations that support and facilitate people engaged in agricultural production to solve problems and to obtain information, skills, and technologies to improve their livelihoods and well-being [34]. Since a livelihood comprises the capabilities, assets and activities required for a means of living, it appears that agricultural extension intends not only to increase productivity and income [17]; [14], but also to improve multifaceted aspects of rural life. It is thus common to associate extension impacts with improvements in productivity and household income of rural households. A worldwide review of extension services also shows that the impact of extension services on rural livelihoods is mixed: very high rates of return in some cases and negligible achievements in other cases [14]; [45]. In support of these findings, [14] also further acknowledges that estimation of extension impact on rural livelihoods is challenging in terms of dealing with attribution issues and linking cause and effect quantitatively.

3. METHODOLOGY

Research design

In order to understand fully the phenomenon of this study, a mix of quantitative and qualitative approaches. Past studies [46]; [47] have shown that the mixed approach is effective for livelihood inquiries. The quantitative component of the study was used to collect quantitative data to understand household behaviour through household survey. The qualitative component of the survey measured variables that generally are inappropriate to determine using quantitative techniques [48] and [49]. Additional techniques were used to collect qualitative data in form of focus group discussions, key informant interviews and participant observation.

Study area location

Two sites were used in this study - Kieni East and Kieni West sub counties located in Nyeri County, Kenya. The two sites depict similar farming systems and socio-cultural settings. Administratively, the study area comprises of four wards in each sub county i.e. Mweiga, Mwiyo/Endarasha, Mugunda and Gatarakwa wards of Kieni West; and Naromoru/Kiamathaga, Thegu River, Kabaru, and Gakawa wards of Kieni East Sub County. The area of study lies within the longitudes of 36°40" East to 37°20" East. The northernmost point of Kieni just touches the Equator (0°) and then extends to 0°30" South. This semi-arid area is sandwiched on the leeward sides of two major water towers in Kenya i.e. Mt. Kenya and The Aberdares Ranges in Kieni East and Kieni West sub counties respectively. The area is thus characterized by high temperatures in low altitude areas and low temperatures for areas adjustment to the two water towers. Kiganjo (1830m) is the lowest area, from where the land rises northwards to the Equator at Nanyuki (2300m), eastwards to Mt. Kenya (>4000m) and westwards to Nyandarua (>3000m) above sea level. These altitudes [50] are believed to affect the amounts of rainfall received in the locality, for example Kiganjo receives about 850mm per annum. This rises eastwards to 2300mm at Kabaru on the slopes of Mt. Kenya and westwards to 3100mm in the Abadare National Park. Therefore, the driest areas are Kiganjo and Naromoru that are within Agroclimatic zones (V) and (VI) respectively. Conversely the mountains (Kenya and The Aberdare Ranges) within zone (I) are the wettest.

Population

According to the 2009 population census [51], the population of Kieni, was estimated at 175,812 (51,304 households) over an area of 1,321Km². Populations are mainly immigrants from the higher potential areas of Nyeri County and surrounding counties in the Mt. Kenya region and The Aberdare Ranges. The study populations were all the 51,304 households. Ten sub locations for this study were randomly selected from a total of 59 sub locations (clusters) in the eight wards (strata). The individual farm household was used as the unit of analysis.

Sample size

The sample size for the study was determined using this formula as proposed by [52] at 95% confidence level and P=0.5, i.e. $n = N/[1 + N(e)^2]$; where: n = the desired sample size; N = population of study (51,304); and e = level of precision (sampling error), the range in which the true value of the population is estimated. In this study, the range was +_5%. Based on these values set for alpha, desired statistical power level, effect size, and anticipated number of predictors, a sample size (n) of 396 (\approx 400) households (200 households for each of the two sites) of study site was considered adequate to balance required level of reliability and cost. The number of ten sub locations was also considered to be sufficiently large for drawing valid statistical inferences and was also manageable to be surveyed with the available resources of finance and time.

Sampling Techniques

In order to represent the population with sufficient accuracy and to infer the sample results to the population, the target sample households were selected in a random two stage sampling process. In the first stage, the study sub locations were randomly selected using proportionate stratified random sampling technique (PSRST) to determine the number of sample sub locations relative to sizes of each stratum (ward) in the population. This resulted in the selection of 10 sub locations; see Table I., each with 40 households according to their respective population strengths. Accordingly, the probability of selecting each of the ten selected sub locations based on population size was determined and varied between 11.1% for Gakanga sub location, and 56.8% for Kamatongu sub location, see Table I. The probability of selecting each household in the selected sub locations based on the population was also determined, and varied from 1.4% for Kamatongu to 10.9% in

Bonden sub location (Table I). The constant overall weight of 1.3 (see Table I) demonstrated that each household in the population had an equal chance of being selected for the household survey interview. In the second stage, using random sampling techniques, individual households units in the selected sub locations were randomly selected in relation to population. Household lists provided by the local administrators (area Assistant Chiefs) of the sampled sub locations were used as sampling frame for selecting households. Accordingly, 400 households (40 households for each of the ten sub locations) were randomly selected for the study (Table I).

Instruments and Data Collection Procedures

A survey using structured questionnaire was the primary method of investigation employed for this study. However, focus group interviews, key informant interviews, and direct personal observations were also used in order to enrich the investigation with relevant qualitative information. A common questionnaire was developed for both study sites. The questionnaire [53], was found to be ideal instrument because it helped to gather descriptive information from a large sample in a fairly short time. The questionnaire was administered in Kikuyu, the local language which households of both sites speak between April and July, 2017. A team of 5 enumerators was recruited and trained for each study site to collect the data from the sampled households. Two separate focus group discussions were conducted for each study site, with male and female household members. The focus group discussions were conducted in June 2017 after some preliminary findings from the questionnaire survey data were investigated. The focus groups composed of between 6 and 9 members of households in both sites. The participants were identified in purposeful selection among the survey samples that were thought to express their views actively in consultation with the enumerators. Village and major town markets in the area were visited to gather information on prices of major traded agricultural, livestock and forest products, including off farm activities. Farm field observation was conducted on some household farms to observe livelihood activities, management practices, and spatial locations in the farmers' land holding.

Data organization and analysis

The analysis involved moderation that implied an interaction effect, where introducing a moderating variable changes the direction or magnitude of the relationship between two variables. In this case, the study was interested in finding out whether the effect of livelihood assets have on livelihood choices depends on extension services provided in the study area. To examine the unique contribution of extension services on the explanation of livelihood choice, a hierarchical multiple regression analysis was applied. Variables that explain livelihood choices were entered in two steps. In step 1, livelihood choice(Y) was the dependent variable and household assets were independent in the regression model (2). Sub variables (see Table II) for household assets(X) included education, transport infrastructure, household income, land, and participation in local institutions; and dependent sub variables comprised of livelihood choices i.e. forest activities, cropping activities, livestock activities and off-farm activities, see Table II. For the final stage of step 1, regression was performed on Y as depended variable while extension services (Z) was independent variable (see model 3). Sub variables for Z were household number of extension officer visits over the last 3 years, and household participation in extension programs during the last 5 years. In step 2, the interaction of X and Z (X*Z) was determined using log linear analysis (see model 4). Before the hierarchical multiple regression analysis was performed, the independent variables were examined for collinearity. Results of variance inflation factor (all less than 2.0), and collinearity tolerance (all greater than .70) suggested that the estimated β s were well established in the regression models. The final stage of step 2 involved regression of X*Z on Y(see Equation (5)).

Based on the following general regression model (1), moderation models were developed.

$$Y = B_0 + B_1 X_1 + B_2 X_2 + \dots + b_k X_k \dots \dots \dots (1)$$

To test moderation, it was first examined whether or not such an effect is significant in predicting Y for interactions X on Y without Z and Z on Y without X and, see Equations (2) and (3) respectively.

$$Y_x = B_0 + B_x X \dots \dots \dots (2)$$

$$Y_z = B_0 + B_z Z \dots \dots \dots (3)$$

Where:

Y_x = Livelihood choice after interaction of X; B_0 = Regression intercept coefficient; B_x = Livelihood asset regression coefficient; X = Livelihood assets variable; B_z = Extension services regression coefficient; Z = Extension services variable

Using log linear regression technique, interaction effect between X and Z moderation was tested and determined whether or not such an effect is significant in predicting Y, see Equation (4).

$$\ln(Y_{XZ}) = \ln \mu + \ln X + B_Z + B_{XZ} \dots \dots \dots (4)$$

Where:

$\ln(Y_{XZ})$ = is the log of the expected cell frequency of the cases for cell xz in the contingency table; $\ln \mu$ is the overall mean of the natural log of the expected frequencies; $\ln X$ = the main effect for variable X; B_Z = the main effect for variable Z; and B_{XZ} = the interaction effect for variables X and Z.

To test moderation, it was examined whether or not such an effect is significant in predicting Y for interactions X*Z on Y, see Equations (5)

$$Y_{x*z} = B_0 + B_{x*z} X*Z \dots \dots \dots (5)$$

4. RESULTS AND DISCUSSION

Descriptive results in Table II show that only 19.8% of the surveyed respondents were visited by extension officers over a period of 3 years. Responses from the two sites were however diverse at $p < 0.05$ significance. Whereas only 7.6% surveyed households in Kieni East confirmed visits by Extension Officers, a greater proportion (33.3%) of respondents in Kieni West testified to have been visited over the same period. Also overall, data in Table II indicate that 24.4% of the study respondents participated in local extension programs. Whereas 42.3% of surveyed households in Kieni West reported to have participated in rural extension activities in the past five years, only 6.3% households in Kieni East benefited over the same period.

Table III shows regression results for the two sites (Kieni East and West) and pooled data. Results indicate that higher level of extension services (Z) [$b = .284$, $SE = .043$, $\beta = .297$, $p < .01$] and more household assets endowment (X) [$b = .344$, $SE = .049$, $\beta = .317$, $p < .01$] were both associated with livelihood choices by households. However, the interaction between livelihood assets and extension services (X*Z) was insignificant [$b = .074$, $SE = .048$, $\beta = .071$, $p > .01$], suggesting that the effect of livelihood assets on livelihood choices was not depended on the level of extension services in the study area. The same result ($p > .001$) is observed for both sites i.e. Kieni East [$b = .179$, $SE = .070$, $\beta = .164$, $p > .01$], and Kieni West [$b = -.047$, $SE = .076$, $\beta = -.046$, $p > .01$], sub counties, where relationship between household livelihood assets and livelihood choices is not depended on the extension activities.

Extension activities moderating effect on livelihood choices

In Table III results show that the interaction (X*Z) between livelihood assets and extension services was insignificant on livelihood choices [$b = .074$, $SE = .048$, $\beta = .071$, $p > .001$]. This suggests that the effect of livelihood asset on livelihood choices was not dependent on extension activities. Table II shows that 19.8% of households were visited by extension agents over the last 3 years, and a proportion of 24.6% of households reported to have received assistance from extension organizations in the study area. The findings are contrary to focused group discussion (FGD) results showing that local extension programs aim to support target groups adopt practices that are sustainable and yet maximise on output for the benefit of farm households. By introducing services in the area, the Ministry of Agriculture and Livestock office confirmed that the overarching goal of their extension services is to improve living standards of the local population through increased productivity and income. The insignificant result of extension service interaction on livelihood choices was corroborated with FGD outcome in which participants expressed their disappointment in regards to extension services in the area. On the state agencies role to improve life in the area, one participant exclaimed

... ..*Sisi huku, nikama tume sahaulika na Serikali!*..Loosely translated“ ...As for us this way, the Government has forgotten us!... (FGD participant, Bondeni Sub Location, Kieni West).

Further discuss around the role of state and non-state agencies came to a consensus that although there were a number of organizations working in the area promoting better lives through extension services, the impact is not felt because of targeting only a selected few.

The regression findings also contradict past studies. For instance, [29] and [17] study on Training and Visit Extension in Asia and Africa showed that since a livelihood comprises of capabilities, assets and activities required for a means of living, agricultural extension not only aim to increase productivity and income, but also to improve multifaceted aspects of rural life. This implies agricultural extension encompasses the entire set of organizations that support and facilitate people engaged in agricultural production to solve problems and to obtain information, skills, and technologies to improve their livelihoods and well-being [34]. Although impact of extension services have been associated with choices to improve productivity and household income, but this study has demonstrated negligible achievement, consistent with other past studies [54]; [14].

5. CONCLUSION

Results show that independently, extension services and household assets have significant effect on rural livelihood choices but the interaction between extension services and household assets has insignificant effect. Accordingly, it is concluded that activities of rural extension services have insignificant impact on the livelihood choices in the study area. The implication is that current extension services in the study do not address livelihood priority needs of the households. Ultimately, households continue to make unsustainable choices for their livelihoods leading to low living standards and environmental damage, a phenomenon common in the study area.

From these results, three types of households may be discerned in the study area. The first type are households that choose their livelihoods based on the strength of their assets only, and the second type choose their livelihood activities based on the extension services advice without consideration of their asset base. Both households end up with livelihood choices that are neither sustainable nor friendly to the environment. The third type of households is those that choose livelihood after considered judgement from the extension agents. Findings, however, show that for this type of households, the impact of extension services on livelihood choices is insignificant i.e. extension services do not result in sustainable livelihood choices. This type of approach to extension is demand driven, indicating that extension services as currently delivered are not demand driven. To control environmental degradation in the study area and promote sustainable livelihood choices, policies that promote demand driven approach for extension service delivery should be put in place. Therefore policies that aim to increase quality of life and enhance environmental conservation should promote demand driven extension services where household asset endowment forms the basis extension programming.

APPENDIX

LIST OF TABLES:

Table I. Sub locations and number of households randomly selected for questionnaire survey

	A	B	C	D	E	F	G	H
Strata/Ward	Cluster/ Sub location	Sub Location Population Size	Cumulative Sum(a)	Clusters sample (d)	Probability 1	Households per Sub Location	Probability 2	Overall weight
Naromoru/ Kiamathiga	Naromoru	1161	1661	1200	32.4%	40	2.4%	1.3
	Ndiriti	1094	2755					
	Gaturiri	1063	3818					
	Rongai	989	4807					
	Kamburaini	1813	6620	6330	35.3%	40	2.2%	1.3
	Thigithi	666	7286					
	Murichu	762	8048					
	Gikamba	1098	9146					
Kabaru	Kabendera	830	9976					
	Kirima	1505	11481	11460	29.3%	40	2.7%	1.3
	Ndaathi	1719	13200					
	Kimahuri	1961	15161					
	Munyu	1020	16181					

Thegu	Thungari	1811	17992	16590	35.3%	40	2.2%	1.3
	Lusoi	605	18597					
	Thirigitu	1446	20043					
	Maragima	872	20915					
Gakawa	Gathiuru	1609	22524	21720	31.4%	40	2.5%	1.3
	Githima	1363	23887					
	Kahurura	5125	29012					
Mweiga/ Mweiga	Bondeni	367	29379	26850	7.2%	40	10.9%	1.3
	Amboni	1194	30573					
	Njengu	784	31351					
	Kamatongu	2915	34272	31980	56.8%	40	1.4%	1.3
Gatarakwa	Watuka	1126	35398					
	Lamuria	1366	36764					
	Embaringo	1217	37981	37110	23.7%	40	3.3%	1.3
	Kamariki	1809	39790					
Endarasha/ Mwiyogo	Mitero	901	40691					
	Charity	1456	42147					
	Gakanga	569	42716	42240	11.1%	40	7.0%	1.3
	Endarasha	1907	44623					
	Kabati	701	45324					
	Muthuini	571	45895					
	Labura	1494	47389	47370	29.1%	40	2.7%	1.3
	Mwiyogo	471	47860					
Mugunda	Karemeno	538	48398					
	Ruirii	993	49391					
	Kamiruri	722	50113					
	Nairutia	1191	51304(b)					
TOTAL	10					400		

Table II. Descriptive statistics of Kieni East, Kieni West, and Pooled Data (all surveyed households)

Variable Description	Kieni East (N= 200)		Kieni West (N= 200)		Pooled Data (N= 400)	
	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
Livelihood asset variables						
% household head with primary education and above	88.2		89.5		88.9	
% household members with primary education and above	93.9		93.7		93.8	
Household nearest average distance to all weather road in Km***	.5578	1.11	1.36	2.05	0.97	1.70
Household average est. annual household gross income (KShs)***	104,859.7	117,317.5	251,012.6	272,571.8	179,595.0	224,095.0
% Household who own land**	88.4		94.0		93.0	
Average size of landholding/household (Acre)	1.80	2.53	2.24	3.57	2.0	3.1
% households who are members of self-help group***	52.6		81.9		67.5	
Livelihood activities/choice variables						
Annual Household income from forest activities (KShs) **	10,459.55	11,653.17	20,995.45	37,383.35	15,727.5	16,603.68
% household who depend on forest for a livelihood***	88.2		100.0	94.8	91.5	
Annual household income from agriculture (KShs) ***	23,056.62	52,615.09	81,033.08	175,790.46	34,430.73	63,077.08
Average number of crop varieties grown per household	4.8		3.8		4.3	
Annual Household income from livestock (KShs) **	29,064.89	37175.48	37,783.08	46,821.33	32,628.93	41,472.23
Average household livestock number in TLU***	12.48	17.06	7.97	9.14	10.23	11.47
Average annual household income from off farm activities (KShs)	63,672.73	70,353.60	68,490.91	142,522.19	66,300.83	115,263.53
**						
% of households who engage in off farm activities **	55.0		66.0		60.5	
Extension services moderating variables						
% of households visited by Extension Field Officer over the last 3 years***	7.6		33.3		19.8	
% of households that have received assistance from extension organizations***	6.3		42.3		24.6	

1. Variables in which sample households of Kieni East have significant differences from those of Kieni West: *** = at 0.01 level of significance ** = at 0.05 level of significance, or *** Significant at 1% level ** Significant at 5% level * Significant at 10% Level

2. 1 US \$=104 Kenya Shillings (KShs) [2017].

Table III. Regression Coefficients (B) and Intercept, the Standardized Regression Coefficients (β), t-values, and p-values for Variables as Predictor of livelihood choices

Model	Variable	Coefficients														
		Kiieni East					Kiieni West					Pooled Data				
		b	SE	Beta β	t-value	p-value	b	SE	Beta β	t-value	P-value	b	SE	Beta β	t-value	p-value
1	1 (Const.)	-	.075		-	.012	-	.077		-	.173	-	.049		-	.023
		.191			2.545		.105			1.369		.111			2.289	
	Livelihood assets(X)	.446	.076	.360	5.844	.000***	.272	.077	.236	3.529	.001***	.344	.049	.317	7.055	.000***
	Extension services(Z)	.311	.059	.324	5.261	.000***	.234	.063	.248	3.705	.000***	.284	.043	.297	6.604	.000***
2	1(Const.)	-	.075		-	.003***	-	.077		-	.180	-	.049		-	.015
		.226			3.005		.104			1.345		.119			2.289	
	Livelihood assets(X)	.447	.075	.353	5.807	.000***	.276	.077	.241	3.567	.000***	.333	.049	.306	6.760	.000***
	Extension services(Z)	.253	.063	.264	5.807	.000***	.215	.070	.228	3.053	.003***	.286	.043	.299	6.660	.000***
	X*Z	.179	.070	.164	4.039	.012	-	.076	-	.540		.074	.048	.071	1.18	
							.047	.046	-6.14						1.566	
					2.540											

a. Dependent Variable: livelihood choices. Where X= livelihood assets, Y= livelihood choices, and Z= extension activities
 *** Significant at 1% level ** Significant at 5% level * Significant at 10% Level

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