The Influence of Household Assets on Livelihood Choices in Kieni Sub Counties, Kenya

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Abstract: **In developing countries, poverty continues to pose livelihood challenges among rural populations. One of the subtle impacts of livelihood assets on livelihood choices is their implication on poverty. Most studies regarding poverty overlook implications of livelihood assets on rural livelihood choices. The purpose of this study is to investigate how livelihood assets influence household livelihood choices 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. Log linear analysis was applied in the determination of influence of livelihood assets on livelihood choices. Based on the analysis, the effect of human, physical, financial, natural and social assets was determined on forest, crop, livestock, and off farm activities. Results show only human and financial assets affects the entire four livelihoods, physical assets three activities and natural and social assets only affected two of the livelihood activities. The asset with the most significant influence was human (education and health) on forest activities [λ=0.470], while local institutions had least influence on forest activities [λ= -0.159]. The results of the study demonstrate that household assets determine livelihood choices, which in the long run affect household wellbeing. The study concludes with some recommendations for policy consideration.**

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

I. INTRODUCTION

Universally, poverty is associated with the rural populations because they are generally deprived of both basic and economic livelihood opportunities. Contemporary apprehensions about the 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 of them relying on agriculture for their livelihoods [1]. 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 associated with the continuous 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. 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, sustainable development goals [4]. However, poverty remains a significant issue despite these efforts. Evidence by [5] illustrates there are millions of people worldwide who are still living in chronic poverty in spite of progress made in the achievement of MDGs.

For decades now, promotion of rural livelihoods to alleviate poverty by rural development agents in developing countries has focused on simplistic approaches of adopting sustainable livelihoods. Consequently, 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, and vice versa. 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 minimal. 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 households' livelihood choices. The body of literature on households' livelihood decisions highlights the complexity of factors involved in the interactive function. The intricacy arises from the diversity of circumstances under which rural households operate. 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 farms.

Livelihood activities are the sources of household means of survival. According to [6], 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, through rural livelihoods diversification, in order to survive. 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 [7]. Although 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 small farm output growth. Therefore, the extent of diversification away from agriculture is an indicator of the degree to which farming operations only cannot provide a secure and improved livelihood.

A study by [1] showed that poverty reduction in sub-Saharan Africa may be achieved through livelihood diversification in rural areas. In consistent with this finding, 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, and 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 implies a shrinking input base for the poor households that increase severity of poverty.

The battle against poverty remains an important agenda on Kenya's development priorities as articulated in Vision 2030, the country's development blueprint for the period 2008 to 2030[10]. 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 continue to be concentrated in rural areas, where their livelihoods [11] depend on subsistence agriculture, making poor farmers encroach on fragile land that lead to degradation of natural resources. The purpose of this study is to determine the influence of rural household assets on livelihood choices of Kieni East and West Sub counties households to earn a living so that rural development programmes objective to improve household welfare and prevent environmental degradation prompted by livelihood pressures can be achieved.

II. 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 and were largely developed by DFID in the 1990s [12], [13]. Livelihood studies in the recent past have come to the fore in response to the limited success of poverty studies [14], [15]. Poverty studies have come to be seen as too engrossed on the powerlessness of poor people, and therefore livelihood approaches [16] enhance 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 [17], [18], [19]. To investigate the behaviour of rural households in their attempt to improve their welfare, the rural household approach is most appropriate since it requires information on household members. Definitional concepts of livelihoods vary among researchers. [20] 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 [21] define a livelihood as comprising the assets, the activities, and the access to these assets and activities as mediated by social capital which together determine the living gained by the rural individual or household. The authors identify assets, mediating processes, trends and shocks, and activities as the critical components and processes that jointly contribute to rural livelihood strategies. Therefore, 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 Livelihood Resources and Activities:

1. Rural Livelihood Resources:

i) Human assets

Labour, health, education, and skills are components of human capital [12], which plays an important role to enable the households pursue different livelihood strategies. But the effectiveness of labour as an asset depends on good health and education. Education in a household comprises of several components, including the overall level of education of the household, gender differences in educational access, and the overall literacy rates of adults in the household [22]. Health, on the other hand, has several components that are considered to be critical in livelihood security. The first aspect is the frequency of illness among all household members. In highly vulnerable households, illness episodes can severely compromise the productiveness of family members, reducing already low levels of incomes and production, thereby affecting food and nutritional security. The second component is access to primary health care. According to [22], health security of rural families is directly related to their level of access to appropriate medical care.

ii) Physical assets

Physical capital is crucial in the development and maintenance of physical infrastructure in rural and urban areas. In developing countries, the physical infrastructure sector is a key pillar in the development of the economies, particularly the productive sectors such as agriculture, industry, and tourism. The main sub-sectors of the physical infrastructure sector are roads, energy, housing, water, and transport. Good infrastructure in rural areas is therefore critical to households' access to markets as well as lowering costs of doing business. The feature of physical capital in rural Kenya can be described as ranging from enabling in some districts to disabling in others [23]. Though there is no definite pattern of correlation between poverty and distribution of road network institutions, regions with lowest key road network institutions per capita have relatively lower welfare than their counterparts with more institutions. Housing as a unit of the environment has profound influence on the health, efficiency, social behaviour, satisfaction and general welfare of the community [24]. The author argues that materials used in the construction of the floor, roof and wall materials of a dwelling unit are also indicative of the extent to which they protect occupants from the elements and other environmental hazards. According to [25], low provision of housing facilities leads to higher incidence of diseases, fewer opportunities for business services, and lack of a conducive environment for learning.

iii) Financial assets

Financial capital is the financial resources available to people either as savings, supplies of credit, regular remittances or pension providing them with different livelihood options [12]. In their study, [26] found that low household incomes in rural areas are associated with low land and livestock holdings, high reliance on food crop agriculture, and low monetization of the rural economy. The authors content that better off households are distinguished by worthy accumulation characteristically involving diverse livestock ownership, engagement in non-farm self-employment, and diversity of on-farm and non-farm income sources. An alternative approach is to treat income as a latent variable and estimate this latent variable based on asset ownership [27], [28] though in practice, the results of the latent variable and principle component measures are very similar. Therefore, in the absence of direct measurement, researchers often use proxy indicators of income based on household ownership of physical assets, such as television, refrigerator, automobile, phone, watch and so forth.

iv) Natural assets

Natural capital relates to the use and availability of natural resources including land, water, environmental resources like forests, and activities such as hunting wild animals, gathering wild vegetables, and so on. A household is regarded as having no natural capital either because it has no landholding at all or where a landholding is owned, the household does not carry out any agricultural activity such as crop cultivation or livestock keeping [29]. Landless households include those engaged in non-agricultural activities, and those rearing livestock on communal land. [29] shows that, on average, 30 percent of rural households are landless and do not practice agriculture as an option for their livelihood in Kenya. Forests are important in the livelihoods of local people in most developing countries. Local people depend on forests resources for various products such as fuel wood, construction materials, medicine, and food. Globally [30], it is estimated that between 1.095 billion and 1.745 billion people depend to varying degrees on forests for their livelihoods and about 200 million indigenous communities are almost fully dependent on forests. Moreover, 350 million people who live adjacent to dense forests depend on them for subsistence and income [30]. It is estimated that 20–25% of rural peoples' income is obtained from environmental resources in developing countries [31] and act as safety nets in periods of crisis or during seasonal food shortages [32].

v) Social assets

Social capital can best be understood as a means for accessing various forms of resources and support through networks of social relations. According to[7] rural households that are endowed with social capital will promote rural development and their welfare in terms of increased growth (e.g., incomes), positive changes including social (e.g., improved access to education, basic health, water, credit, etc.), political and cultural changes as well as traditions, customs, morals, ethics and attitudes. Social capital is thus important in improving the livelihoods of rural people through increase in access to goods and services. Social capital is therefore essential for facilitating and sustaining diverse income portfolios and access to opportunities and resources to individual households [33], [34]. Further, [35] emphasize that social capital is a useful resource that underpins the livelihood strategies of the rural household as it enables participants to act together more effectively in pursuit of shared objectives. The authors explain that social capital enhances rural livelihood directly and also increases access by people to goods and services particularly those that exhibit public good characteristics. Documented work related to social capital in Kenya is pretty recent. [36] provides and identifies the work of [37] as being the earliest. Since the year 2000, there has been growing interest amongst researchers and scholars in studies on social capital.

2. Rural Livelihood Activities:

Rural households engage in a variety of activities to support their wellbeing. Various scholars have defined livelihood in different but related fashions. Livelihood activities according to [6] are the activities, assets and the access that jointly determines the living gained by the rural households, but [38] simply identifies a livelihood activity as a means of gaining a living. Often household diversify livelihood activities to guarantee survival in case there is failure in one or the other. Here, again, meaning of livelihood diversification varies amongst scholars. It is defined as the course by which households establish progressively diverse livelihood portfolios [39], adequate stocks and flows of cash to meet basic needs [40], and it is a form of self-insurance [41]. [12] explains that a livelihood is sustainable when it has the capacity to meet the immediate needs of the people without jeopardizing its ability to meet future needs. Different scholars [40], [42] identified several types of livelihood diversification activities adopted by rural households in development countries. The authors content there are four distinct rural livelihood strategies, including on-farm agricultural production, unskilled on-farm or off farm wage employment and non-farm earnings from trades, commerce. The third strategy entails skilled employment and the fourth, is mixed strategy that combines all the above three strategies. The components of rural livelihood diversification are also classified by sector as farm or non-farm, by function as wage employment or self-employment or by location as on-farm or off-farm [38].

[23] studied livelihood of arid and semi-arid lands (ASAL) communities in six districts and reported how rural Kenya households have a wide variety of activities. On average, the study found that rural households are involved in 3.6 different livelihood activities. The main livelihood activities included livestock (livestock marketing, hides and skins, butchery, herding, sale of livestock products), fruit and vegetable, casual labour, firewood and charcoal, business, employment, kiosk and hotel, and handcraft manufacture. Based on these findings, two main categories of livelihoods relevant in the study area may be discerned i.e. on farm and non-farm. On farm activities are largely crop and livestock activities; and non-farm as off farm and forest based activities.

Forest based activities

Forests are an important resource where many people rely heavily on for their livelihoods. Some use it for subsistence i.e. timber, fuel wood, wild foods (animal and plants), medicinal plants, other non-timber forest products, grazing for animals, forest based agriculture, and nutrient supplements for agriculture. Others use forest for food, income generation i.e. sale of the above products, or sell of agricultural or livestock production dependent on forests. Lastly, some people dependent on forest for income from forest based labour by working in different forest based works. Previous studies[31] indicate that as much as 20-25% of people's rural income may be derived from environmental resources in developing countries. Poor people typically engage more in low return forest activities, but often fail to accumulate capital from such activities.

Crop based activities

Crop expansion is one of the coping mechanisms for managing food security, production and market risks. For example, crop diversification was the single most important source of poverty reduction for small farmers in South and Southeast Asia [43]. In consistent with this finding, [44] identified three key factors that drive farmers' motivation for crop diversity: i) managing risk, ii) adapting to heterogeneous agro-ecological production conditions, and iii) meeting market demands and food security. [45] also confirmed that households in Central and Eastern highlands of Ethiopia would be able to improve their food security conditions by enhancing their crop diversification. With heterogeneity in agro-ecological, social and economic conditions, farmers' agriculture in Kenya is also highly diversified to meet own consumption and market needs, to withstand price fluctuation and to manage income risks. Crop diversification is therefore considered as an important step in the transition from subsistence to commercial agriculture. As [46] found out, a shift from food production for own consumption to a cash crop production contributes to improvement of income for smallholders.

Livestock based activities

In many developing countries as is the case in Kenya, rural households earn a living from livestock farming and consider keeping livestock as a store of wealth [47]. Livestock makes a multifaceted contribution to the social and economic development of the rural populations. Several factors have contributed both positively and negatively to changes in livestock numbers. Some of these factors are economic growth and increased incomes [48]; increase in demand for livestock products arising from rapid growth in human population and urbanization [49], [50]; changing food preferences [51]; changes in climatic conditions [47], among others. In West Africa, as in other developing countries, livestock plays an important role in the rural livelihoods by providing different functions, such as food, income, and other cultural and social functions. For the average rural farmer, livestock provides a buffer stock and an effective hedge against income fluctuations [52]. [53] adds that socio-economic and environmental factors such as population growth, urbanization and economic development, changing livestock market demands, impacts of climate variability and science and technology trends have contributed to the changes in livestock numbers in Kenya.

Off farm activities

There has been an increasing recognition that the rural economy is not confined to the agricultural sector alone [54], mainly because the number of poor people in rural areas exceeds the capacity of agriculture to provide sustainable livelihood opportunities in many parts of the world [55]. Dependence upon subsistence farming confronts households with a precarious living, exposing them to adverse contingencies, which makes them 'risk managers'. Consequently, the economic activity of poorer people seeks to spread risk among many sources of income and sustenance rather than depending upon a single occupation [56]. [57] found that rural non-farm economic activities may among other things; absorb surplus labour in rural areas, help farm-based households spread risks, offer more remunerative activities to supplement or replace agricultural income, offer income potential during the agricultural off-season, and provide a means to cope or survive when farming fails. Also in terms of employment, [58] shows that the share of the non-farm sector in rural employment in developing countries varies from 20% to 50%. Further, in term of income, [59] demonstrates that rural non-farm income shares in Africa ranged from 22% to 93%, while [7] reports that 30–50% share of non-farm income is common in sub-Saharan Africa. The potential role of the rural non-farm sector in sustaining rural livelihood has attracted the attention of the Kenya government and government policies and strategies are now focused on the development of the agricultural sector and the generation of non-farming opportunities in rural areas across the country [10]. In the face of acute weather variability, off-farm activities could become attractive adaptation options to agricultural

activities. Although rural households tend to turn to off-farm activities to meet their needs and offset income shortfalls, participation appears to be constrained by capital assets-human, social, financial, and physical. In their study of off-farm employment participation in Honduras, [60] demonstrate that educated and wealthier households take advantage of their human and physical capital by participating more in off-farm activities.

3. Livelihood Assets and Livelihood Choices

The theory of livelihoods places emphasis on urgency for maintaining people's possessions including capital assets as a prerequisite for survival [61]. In rural Kenya, as in other rural areas, households depend for their livelihoods on five capital assets including natural capital, physical capital, human capital, financial capital, and social capital. Access to all capital types is required for a sustainable livelihood [23]. The analysis of rural livelihood choices is complex because households engage in a variety of economic activities. People thus make their living by combining a complex web of activities and interactions. According to previous studies [26], [7], [62], rural households diversify their livelihood activities to generate income and better cope with adverse factors and events that affect agriculture. Although rural households in developing countries pursue a wide range of livelihood activities [63], there is a common notion that there exist, to some degree, distinct livelihood strategies across rural households [64].

III.   METHODOLOGY

Research design:

In order to understand fully the phenomenon of this study, a mix of quantitative and qualitative approaches was used because from past studies [65], [66] the approach is effective for livelihood investigations. 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 [67], [68]. 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, in Nyeri County in Kenya. The two sites depict similar farming systems and socio-cultural settings. The study area comprises of four wards in each sub county i.e. Mweiga, Mwiyoyo/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. The area is sandwiched between 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 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 [69] 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 Narumoru 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 [70], 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 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 [71] 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 (≈ 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 Bondeni 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[72], 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 organisation and analysis:

The data was coded and entered into SPSS in three separate data files; one for Kieni East, the second for Kieni West, and the third for pooled data. To estimate influence of livelihood assets on livelihood choices, log linear model was used since it enabled the study of relationship between categorical variables. The first category comprised of livelihood assets variables, while the second was livelihood activities, see Table II. Assets included human(education and health[EH] variables); physical(housing and transport[HT] variables); financial(household income and assets value [HIA]); natural(land and forest access[LF]); and social(local institutions[LI] variables. Livelihood activity variables comprised of four categorical variables i.e. forest activities [FA] (average annual gross income from forest products, and proportion of households who depend on forest); crop activities [CA] (average household annual crop income, and number of crop varieties); livestock activities [LA] (household average annual estimated livestock income, and average number of livestock owned), and off farm activities [OA] (estimated average household annual off farm estimated income; and proportion of households who engage in off farm activities), see Table II.

The Log linear Model:

In the log linear model, hierarchical approach was adopted by including five variables at a time i.e. one livelihood asset variable and four livelihood activity variables [73]. For instance the model for human asset[EH] variables regression on livelihood activities (FA, CA, LA, OA) the model used for the first hierarchy, considering only interactions up to the second order was:

$\text{Ln}(F_{EH.FA,CA.LA,OA}) = \square + \square^{EH*FA} + \square^{EH*CA} + \square^{EH*LA} + \square^{EH*OA}$

where:

$\text{Ln}(F_{EH.FA,CA.LA,OA}) =$ is the log of the expected cell frequency of the cases for cells EH.FA, EH.CA, EH.LA, and EH.OA in the contingency table; $\square =$ is the overall mean of the natural log of the expected frequencies; $\square^{EH*FA} =$ the interaction effect for variables EH and FA; $\square^{EH*CA} =$ the interaction effect for variables EH and CA; $\square^{EH*LA} =$ the interaction effect for variables EH and LA; and $\square^{EH*OA} =$ the interaction effect for variables EH and OA.

The similar models were used for subsequent hierarchies for (HT), (HIA), (LF), and (LI) on (FA, CA, LA, OA).

IV. RESULTS AND DICUSSION

Understanding rural livelihood activities and household asset dependence can help to improve household welfare and prevent environmental degradation prompted by livelihood pressures. Table III. shows results of the maximum likelihood estimation of the log linear regression model specified for the decision to adopt livelihood activity by the sampled households in the study area.

Household assets influence on Forest activities (FA):

Results in Table II. show 45.8% of respondents engage in forest activities. Results also indicate that all the five livelihood assets (human[EH], physical[HT], financial[HIA], natural[LF], and social[LI] assets) influence household dependence on forest activities. The interaction of education & health and forest activities (EH*FA) is positive indicating that the probability of engaging in forest activities (FA) increases with household education and health status ($\lambda=0.470$; Z=8.363, p<0.05). This result is contrary to [12] and [74] finding that human capital (labour, health, education, and skills) is an important asset that enables the household to pursue different livelihood strategies other than forest dependence. According to focused group discussions (FGDs) results, the explanation for the divergence may lie in the fact that high unemployment in the area has forced educated household heads members of the community to seek alternatives for a living by exploring opportunities in the forests. Traditional beliefs on the part of some households was also argued as a reason behind some members of the community who still rely on the forest for traditional medicine in spite of the improved health services in the area, adding that cost of health care services may be beyond the reach of some households.

The positive interaction coefficient for housing & transport*forest activities [HT*FA] shows that the prospect of engaging in forest activities is dependent on household housing and transport factors ($\lambda=0.201$; Z=3.81, p<0.05). [24] opines that the type of house in which a person lives and socializes impacts on his or her belief system and moulds his/her personality. Over 90% (Table II) of respondents own and reside in semi-permanent houses made of timber walling. According to [25], materials used in the construction of house wall, roof and floor are indicative of the extent to which they protect the occupants from the ailments and other environmental hazards. FGDs results at both sites showed that local weather conditions make timber a suitable material for the construction of house walls, which may be the justification for household dependency on forest for housing. Results (Table II) also show that the average household distance to nearest all weather road was less than 1km, which reinforced the FGDs members assertions that road network in the area has improved over the last 5 years. According to [75] and [23], who studied importance of road in in Kenya and Uganda, roads play an important role in marketing of farm products. The improved road network has facilitated transportation of agricultural and forest products from the forests, according to FGDs results.

Dependency of households on household income and assets [HIA] for forest activities was also found to be positive($\lambda=0.181$; Z=3.537, p<0.05). Results (Table II) show that average annual income for households in the study area was KShs 179,595.00[$4.8], which is above the 1$ per day international poverty line. These results supports the outcome from regression analysis indicating that households endowed with financial resources are likely to access forest resources compared to the less endowed ones. This is because such households can afford to pay requisite fees for legal access to

forest resources as per laid down regulations. According to FGD results in both sites, it was revealed that some households are involved in illegal transaction with unscrupulous forest officers whom they pay bribes and get their way into the forest illegally. In this way, household with financial resources are able to expand their land for farming and grazing, and at the same time allowed to engage in other activities like logging in the forests. In general, the findings are in conformity with FGDs results that showed households depend on forest products, and agriculture and livestock in the forest to raise additional income, in consistent with [31] study which found that as much as 20-25% of people's rural income may be derived from environmental resources in developing countries.

The interaction parameter of land and forest access and forest activities [LF*FA] was similarly positive signifying that the probability of engaging in forest activities by households is dependent on land and forest access (λ=0.273; Z=5.216, p<0.05). Also Table II shows that 93% of households own land in the area, and the average household distance to the forest was 7.57km. Owning land is paramount in Kenya [29], and so landless households are forced to access forest as safety net, especially during seasonal food shortages [32]. According to FGD results at both sites land ownership in the area is a precondition to access forest resource, buttressing the importance of land ownership in the area. This may explain why those who are landless access the forest illegally as squatters who are subjected to constant evictions.

The interaction parameter for local institutions and forest activities (LI*FA) is negative [negative parameter estimate but significant at p<0.05] (λ= -0.159; Z=-2.88, p<0.05). Results (Table II) show that about 65% of surveyed respondents were members of self-help groups and less than 30% participated in extension services provided by external institutions. The result indicate that the stronger the social capital, the less dependency of households on forest resources. According to FGDs results, households who venture into forest for livelihood often do so at personal rather than community initiative. The results further revealed that even the local community organisations like the Community Forest Associations (CFAs) are bedevilled with organisation and leadership challenges, and thus their role in forest conservation is not quite recognised by the local households. The results therefore show that strengthening social capital in the area will lessen household dependence on forest resources, and also as argued by [35], strong social capital underpins the livelihood strategies of the rural household by enabling participants to act together more effectively in pursuit of shared objectives.

Household assets influence on Crop activity (CA):

Results indicate that apart from physical assets (housing and transport), all other livelihood assets affect crop activities (CA). Results in Table II indicate that 76.5% of survey respondents engage in farming. Also in Table III, the interaction parameter for health and education*crop activities [EH*CA] is positive indicating that the likelihood of engaging in crop activities is depended on education and health factors (λ=0.249; Z=4.179, p<0.05). The level of education of the household head impacts on their participation in agricultural activities. Common crops grown in the area include cabbage, onions, potatoes (Irish), tomatoes, maize, and beans. Others are cassava, pumpkins, Kales(*Sukuma Wiki*), oranges and bananas. Education often serves an enabler for transmission of specific information needed for a particular task and shapes attitudes, beliefs and habits. Table II shows that over 90% of household heads are educated up to primary education level or above, indicating high literacy level in the study area. This finding is in concurrence with [76] finding that many farmers in rural areas do not have the most up-to-date information on how to grow food efficiently and economically due to low education levels. Results also showed that Kieni population has health service satisfaction rate of over 70%(Table II). With relatively healthy population status, the influence on cropping activities is positive. The findings are therefore in line with [22] report that in highly vulnerable households, illness episodes can severely compromise the productiveness of family members, reducing already low levels of incomes and production.

Table III results show that overall interaction coefficient of HIA*CA is positive demonstrating that the chance of engaging in crop activities is also dependent on household income and asset status (λ=0.160, Z=2.703, p<0.05). Households in the area engage in both farm and non-farm to raise income with annual average income of KShs 179,595.00(Table II.) which is partly used to support their farming endeavours. Studies (e.g. [77]) show that farm households who engage in nonfarm employment tend to enjoy higher household incomes and produce agricultural products more efficiently, suggesting the vital role of nonfarm activities in raising farm households' incomes and improving farming practice. In addition, household physical assets like livestock, farm equipment, motor cycles, vehicles, ox carts, among others are key enablers to farming households in terms of either risings cash e.g. livestock for farming or using some of the assets to carry out farming activities e.g. farming equipment.

Table III results indicate that LF*CA interaction parameter is positive showing that the probability of engaging in crop activities is dependent on natural resources (λ=0.171; Z=2.873, p<0.05). Over 93% (Table II) of household own land and this may be the reason behind the high proportion of households who engage in farming activities. The average landholding in the areas (Table II) is 2.0 acres which is less than the national average of 2.47 acres [29] in Kenya. Therefore since majority of households have small parcels of land, they seek additional land for farming in the forest as strategy to diversify more on crop production. This includes the 7% of respondents who do not own land. Under the circumstances, forest becomes one of the determining factors of farming in the study area, therefore acting (forest) as safety nets in periods of crisis or during seasonal food shortages [32].

The relationship between local institutions and crop activities was found (Table III) to be negative but significant (λ=-0.142; Z=-1.985, p<0.05). Therefore the probability of engaging in crop activities is lower for households with strong social capital. These results show that local institutions in the study area are important but do not play a positive role in promoting cropping activities. The results are contrary to finding by [35] who pointed out that social capital is a useful resource that underpins the livelihood strategies of the rural household as it enables participants to act together more effectively in pursuit of shared objectives. The finding was nevertheless consistent with results from FGDs in both sites which revealed that most of the members in local community groups join groups only for social reasons. For instance, FGDs outcomes show that self-help group members are mainly motivated to join social groups for support during funerals and wedding functions.

Household assets influence on Livestock activity (LA):

Relationship between education & health and livestock activities was also found to be positive (Table III) indicating that the likelihood of engaging in livestock activities is dependent on human assets (λ=0.125; Z=2.148, p<0.05). Common in the area include livestock kept cattle, sheep & goats, donkeys, and poultry. Average household education and health services satisfaction in the area was 79.8%/71.35% (Table II) respectively. Therefore, households with good access to primary education and health services have a better chance of engaging in in livestock keeping according to the findings. Also previous studies indicate a positive impact of education and health on livestock keeping [78]. The suggested reason for the positive relationship is that smallholder livestock production depends on how farmers are able to adopt recommended innovations. Furthermore, in his study on livestock production, [50] opined that future demand for livestock products will be heavily moderated by socio-economic factors such as human health as demonstrated by this finding.

Results (Table III) of interaction coefficient for housing and transport, and livestock activities demonstrates that the probability of engaging in livestock activities is dependent on household physical assets inform of housing and transport infrastructure (λ=0.294; Z=4.43, p<0.05). Over 90% [Table II] of respondent households own houses in the study area, implying their ability to provide additional housing for livestock. In his study, [79] showed the need for livestock to be housed in such a way to maximize performance and reduce stress induced behaviours. The vulnerability of animals to weather is well established, even their performance and survival are strongly influenced by direct effects of weather, the author argues. As was confirmed during FGDs at both sites, materials for livestock house construction is acquired on the farms but mainly from the forest. Although the need to transport food animals occurs essentially in commercial agriculture, to some extend too is necessary in the rural or subsistence sector. FGDs in both sites revealed that animals in the area are moved for reasons like marketing, slaughter, restocking, moving from drought areas to better grazing and change of ownership. They (FGDs) reported that improved road infrastructure in the study area over the last five years has greatly improved livestock production, a result that is consistent with [23] study on impact of physical capital in Kenya.

Interaction parameter for household income and assets and livestock activities(Table III) is positive showing that the probability of engaging in livestock activities is also dependent on household financial and asset resources (λ=0.200, Z=3.363, p<0.05). Farm households endowed with income and assets were more likely to engage in livestock production activities in the study area. Results [Table II] show that average gross income for households in the study area was KShs 179,595.00, which is above the international poverty line of less than 1$ per day. These results are in consistent with previous study by [26] that showed low household incomes in rural areas are associated with livestock holdings. Livestock is invariably subject to negative impacts of disease and weather. FGDS revealed that due to the harsh weather in the area like drought, farmers are occasionally compelled to dispose their livestock at throw away prices or loose altogether through death. When the weather finally recovers, restocking of livestock becomes necessary, and only those households with sound financial capital are capable to refinance livestock farming. Furthermore, management of disease

and feeding are resource intensive and famers with limited financial power find disease control and general livestock management difficult to cope with.

Household assets influence on off farm activities (OA):

In Table III it is shown that interaction coefficient for education and health, and off farm activities was explicit. This demonstrates that the probability of engaging in off farm activities was contingent on education and health (λ=0.175; Z=2.708, p<0.05). Table II shows that 60.5% of respondents engage in off farm activities like casual employment and small businesses. Regression results show that the level of household education and health combined was positively associated with the likelihood of engaging in off farm activities. Whether it is formal employment or self-employment, the role of education in a person's ability to be employed or run business respectively is central. Available studies also corroborate the positive impact education and health on off farm activities. [57] found that better educated members of rural populations have better access to any non-farm employment on offer, and are also more likely to establish their own non-farm businesses. In consistent with this finding, also [77] pointed out that education was as a key determinant of participation in the remunerative non-farm sector, while [80] established a strong, significant association between traditional rural non-farm economy and human assets. In addition [22] reported good health influences one's ability to be more productive at work and so is the dependency of off farm activities on health access, especially primary health care. Results indicate, therefore, there is possibility that health status exerts a positive and significant influence on the likelihood of household to engage in off farm activities.

Results in Table III show that interaction parameter for housing & transport, and off farm activities is positive signifying that the prospect of participation in off farm activities is dependent physical facilities (λ=0.160; Z=2.319, p<0.05). The results show that housing situation and transport network are crucial to the successful participation in off farm activities as both affect marketing, among other functions of business. It was also clear from FGDs at both sites that house ownership is associated with peace of mind that comes with it [24]. The state of mind is critical persons engaged or managing non-farm activities for the main purpose of raising income. According to [25], low provision of housing facilities leads to higher incidence of diseases, and fewer opportunities for business services. Further, access to transport network is also important for household who get involved in off farm activities to expand their income horizon. Although rural households tend to turn to off-farm activities to meet their needs and offset income shortfalls, participation appears to be constrained by physical assets, among other capital assets. Whether it is movement to work as employee and casual worker, products to and fro the market, access of social amenities like health, and so on depend on satisfactory transport infrastructure available for use.

Table III results show that the interaction coefficient for household income and assets collectively, and off farm activities is positive indicating that the probability of engaging in off farm activities is dependent on household financial and asset resources (λ=0.131, Z=2.019, p<0.05). Results show that income and assets of households was jointly positively associated with the likelihood of engaging in off farm activities in the study area. During FGDs at both sites, it was revealed that one of the greatest challenges to business entrepreneurs in the area was lack of capital. This finding on overall [HIA] positive relation may be explained by the fact that investment in off farm activities requires financial resources. It is mostly households who have the requisite capital that are likely to get involved in self-employment as entrepreneurs compared to those with limited or no income. For instance lack of capital has been found in previous studies [81] to be the main constraint to starting and running small and micro enterprises(SMEs) in rural areas. Also regression findings are in conformity with [82] study in Peru which reported that limitations from access to credit are detrimental to household income diversification strategies.

V. CONCLUSION

The results show that human and financial assets affects all the four livelihood activities, physical assets three, while natural and social assets only affects two livelihoods. We also find evidence of negative association between livelihood activities and social capital. Our analyses indicate that household endowment of assets is strongly associated with livelihood choices. We found the strongest and weakest association between human and social assets and forest activities respectively. The results demonstrate the importance livelihood assets play in household livelihood choices in the study area. First, forest activity was the only livelihood influenced by all the five household assets i.e. human, physical, financial, natural and social assets. The greatest influential asset was education and health, indicating the importance of human assets in forest activities, in consistent with [12], [74] findings that enhancement of education standards is a strategy to dissuade household dependency on forests. Secondly, it is concluded that the most influential effect on crop

activities was from education and health, where as shown by [76], improvement of education promotes household ability to acquire up to date information on sustainable and economical farming techniques. Thirdly, the greatest influence on livestock activities came from housing and transport factors, demonstrating significance physical factors play in livestock production, especially housing infrastructure [79]. Finally, off farm activities, were influenced most by education and health factors, consistent with [77] finding that human assets are key determinants of participation in the remunerative non-farm sector.

Therefore, policy recommendations for sustainable livelihood choices should be developed based on evidence from livelihood choices founded on livelihood assets. In order to safeguard standards of living for marginalised populations, it is necessary to ensure continued access to livelihood assets so that more households can get engaged in preferred livelihood choices. It is imperative to remove constraints to, and expansion of opportunities for, livelihood assets access, because these policies will give households more capabilities to improve livelihood security and to raise household wellbeing. Policy makers must recognise the barriers to the adoption of the more sustainable livelihood strategies, based on the livelihood assets comparative advantage of rural communities. Future rural policies should promote policies that enable poorer households to gain access to financial, physical and human assets to help correct the imbalance of opportunities that exists in Kieni East and West sub counties.

APPENDIX-A

LIST OF TABLES:

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

Strata/Ward	A Cluster/ Sub location	B Sub Location Population Size	C Cumulative Sum(a)	D Clusters sample (d)	E Probability 1	F Households per Sub Location	G Probability 2	H 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					
	Kabendera	830	9976					
Kabaru	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.
Household activities						
% household who engage in forest activities	39.2		52.2		45.8	
% household who engage in crop activities	64.5		88.5		76.5	
% household who engage in livestock activities	47.0		32.5		39.8	
% household who engage in off farm activities	55.0		66.0		60.5	
Livelihood assets						
Household average distance to the nearest public school in Km	1.56	.88	1.64	1.33	1.61	1.13
% households satisfied with education facilities in the area**	85.3		74.3		79.8	
Household average distance to the nearest public health facility in Km	6.17	5.78	5.53	3.92	5.8	5.0
% households satisfied with health services***	80.1		62.6		71.35	
% households who own a house	*91.8*		*92.2*		*91.5*	*1.70*
*Household nearest average distance to all weather road in Km***	*.5578*	*1.11*	*1.36*	*2.05*	*0.97*	
Household average annual household gross income (KShs) ***	104,859.7	117,317.5	251,012.6	272,571.8	179,595.0	224,095.0
Household average asset value(KShs) **	9,798.26	19,394.8	8,757.84	30,287.68	9,278.05	25,404.78
*% 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*
*Household distance(km) to the nearest forest***	*4.56*	*3.759*	*10.48*	*18.411*	*7.57*	*13.686*
% Household who participated in rural extension program(external institutions) over the last 5 years***	7.9		48.0		28.4	
% of households who are members of self-help group(internal institutions)***	52.6		81.9		67.5	
Livelihood activities						
*Annual Household income from forest activities (KShs) **	*10,459.55*	*11,653.17*	*20,995.45*	*37,383.35*	*31,455.20*	*21,554.19*
*% of household who depend on forest for a livelihood***	*96.2*		*100.0*		*98.4*	
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*	*37,175.48*	*37,783.08*	*46,821.33*	*32,628.93*	*41,472.23*
*Average household livestock number in TLU***	*12.48*		*7.97*		*10.23*	
Average annual household income from off farm activities (KShs) **	63,672.73	70,353.60	68,490.91	142,522.19	66,300.83	115263.53
% of households who engage in off farm activities **	55.0		66.0		60.5	

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.

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

Table III. Parameter estimates and respective z and p values for Kieni East, KIeni West and pooled data

Parameter	Kieni East			Kieni West			Pooled data		
	Estimate (λ)	Z	p-value	Estimate (λ)	Z	p-value	Estimate (λ)	Z	p-value
Education & health*Forest Activities[EH*FA]	0.322	3.076	0.002	0.410	3.540	0.000	0.470	8.363	0.000
Housing & transport*Forest Activities[HT*FA]	0.147	1.979	0.048	0.221	2.877	0.004	0.201	3.81	0.000
Household income & assets*Forest Activities [HIA*FA]	0.165	2.265	0.024	0.131	1.728	0.084	0.181	3.537	0.000
Land and Forest Access*Forest Activities[LF*FA]	0.177	2.407	0.016	0.313	4.023	0.000	0.273	5.216	0.000
Local institutions *Forest Activities[LI*FA]	-0.104	-1.468	0.142	-0.026	-0.199	0.842	-0.159	-2.88	0.000
Education & health*Crop activities[EH*CA]	0.281	3.227	0.001	0.205	2.296	0.022	0.249	4.179	0.000
Housing & transport*Crop activities[HT*CA]	0.033	0.396	0.692	0.14	1.606	0.108	0.095	1.572	0.116
Household income & assets*Crop activities [HIA*CA]	0.146	1.731	0.083	0.151	1.756	0.079	0.160	2.703	0.007
Land & forest access*Crop activities[LF*CA]	0.437	4.103	0.000	-0.082	-0.897	0.370	0.171	2.873	0.004
Local institutions*Crop activities[LI*CA]	-0.161	-1.985	0.047	-0.051	-0.358	0.720	-0.142	-2.332	0.020
Education & health*Livestock activities[EH*LA]	0.168	1.917	0.055	0.13	1.525	0.127	0.125	2.148	0.032
Housing & transport*Livestock activities[HT*LA]	0.382	3.375	0.001	0.252	2.985	0.003	0.294	4.43	0.000
Household income & assets*Livestock activities [HIA*LA]	0.263	2.723	0.006	0.191	2.367	0.018	0.200	3.363	0.000
Land & Forest Access*Livestock activities [LF*LA]	0.243	2.516	0.012	-0.033	-0.391	0.696	0.073	1.266	0.205
Local institutions*Livestock activities[LI*LA]	-0.124	-1.465	0.143	-0.123	-0.949	0.343	-0.072	-1.17	0.242
Education & health*Off farm activities[EH*OA]	0.141	1.375	0.169	0.287	3.246	0.001	0.175	2.708	0.007
Housing & transport*Off farm activities[HT*OA]	-0.016	-0.161	0.872	0.315	3.339	0.001	0.160	2.319	0.020
Household income & assets *Off farm activities [HIA*OA]	0.321	2.598	0.009	0.079	0.924	0.355	0.131	2.019	0.043
Land & forest access*Off farm activities[LF*OA]	0.057	0.552	0.581	-0.198	-2.041	0.041	-0.104	-1.595	0.111
Local institutions*Off farm activities[LI*OA]	-0.182	-1.778	0.075	0.305	1.4	0.162	0.018	0.248	0.804

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