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ASSESSMENT OF ON-FARM DAIRY DIVERSIFICATION PROJECTS IN ENHANCING LIVELIHOODS OF SMALL SCALE FARMERS IN BURETI SUB-COUNTY, KENYA

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Abstract

Dairy farming is an important agricultural sector and highly enriched with agro-ecological, political and social dimensions. Much of this milk is produced by smallholder dairy farmers who account for 80% of the national milk production in Kenya. However, smallholder farmers fetch considerably low incomes. This study assessed the contribution of on-farm dairy diversification projects in enhancing the livelihoods of the small scale farmers in Bureti sub-county. A descriptive research design was adopted with a target population of 280 respondents. Random sampling was used to select 74 respondents. A semi-structured questionnaire was used to collect primary data on a drop and pick later basis. The collected data was edited, coded and analyzed using descriptive and inferential analyses using SPSS 23. The study established that insufficient dairy funding affects on-farm dairy diversification projects, lack of reliable livestock extension services and training on dairy production hinders dairy farming activities. Smallholder dairy farmers are not often trained on production risks. The study recommended that smallholder dairy farmers should seek sufficient dairy funding, livestock extension services and training of smallholder dairy farmers on production risks should be enhanced.

Keywords: Dairy; Diversification; On-farm; Funding; Technology; Adoption; Risk; Production; Sustainability

INTRODUCTION

Dairy farming is an important agricultural sector and highly enriched with agro-ecological, political and social dimensions across countries, region and the vast continents. According to (Knechtges, 2011), approximately 900 million of the worlds' 3.3 billion people are poor and live in rural areas. Majority of these people depend on agricultural activities for food and income according to (OECD, 2002). Dairy farming directly and indirectly utilize 80% of land surface and it is projected to escalate to the tune of 30% of total value of the global agricultural production. In United States of America (USA), dairy farming is large scale and highly mechanized with milk marketing mostly done through cooperatives. Dairy product sales represented 42 percent of the total commodity marketing by Agricultural Cooperatives in 2007 alone. The Danish dairy industry can be traced back into 18th century and consists of the international dairy group Foods and 30 smaller dairy companies, together processing 4.7 billion kilograms of milk from a total of 61 production plants in Denmark (Knechtges, 2011). Cooperatively owned by Danish and Swedish milk producers, Foods is Europe's largest dairy group. The group processes more than 90 percent of the Danish and two thirds of the Swedish milk pool. It also runs dairy operations in a number of other countries, with UK placed as its three biggest businesses (Michels, 2010).

In South Africa, dairy production has changed significantly as a result of technological advances especially in feeding forms, milking systems, biotechnology and housing. Dairy cows seemingly reducing as a result of decreasing dairy farms (Metcalfe, 2014). In Tanzania, farmers consider the dairy industry as one of their main sources of income (Bayer et al., 2006). Resource poor farmers derive their income from livestock and use them to purchase agricultural inputs such as fertilizer, herbicides and pesticides and also use the incomes to improve their livelihoods. According to Ngigi (2004), milk production increased during the 1990s was at an annual rate of 4.1% in Kenya and 2.6% in Uganda.

Kenya is the leading milk producer in Eastern Africa and produces an estimated 4 to 5 billion litres of milk annually from a herd of about 4 million dairy cows. Much of this milk is produced by smallholder dairy farmers who account for 80% of the national milk production (Backlund, 2009). In addition, agriculture is the backbone of Kenyan economy and dairy production alone contribute 21% of the total 40% agricultural produce of the GDP and 3.5% of the total GDP according to (Knechtges, 2011). Small scale dairy production systems range from stall-fed cut-and-carry systems, supplemented with commercial concentrate, to free grazing on unimproved natural pastures in the more marginal areas. Upgraded (crossbred) dairy cow breeds are kept under the zero grazing system or under the semi-zero-grazing systems (Halberg, 2006). Dairy production in Kenya is divided into small scale and large scale with the small scale farming being the most popular as it constitutes 70-80% of the total dairy subsector

(Ngigi, 2003; Karanja 2004; IFAD, 2006). The smallholder group is also divided into four sub-groups which are resource poor, small scale intensive, part time dairy farmers and crop oriented dairy farmers (IFAD, 2006). These groups have different characteristics which make them have different constraints.

According to the Ministry of Livestock (2003), Rift-Valley provinces produced 50% of the country's 3.196 billion litres of milk with Nakuru district contributing 8.6% of the milk output. In Africa, Kenya is the only country, after South Africa that produces enough milk for both domestic consumption and export. Sudan on the other hand is the largest producer of milk in the Common Market for Eastern and Southern Africa (COMESA), but it does not produce enough to satisfy both domestic and export markets. The dairy industry is the single largest agricultural sub-sector in Kenya, larger even than tea (Muriuki, 2004). Large scale dairy farming accounts for 20% of national milk production while 80% is from small scale farming. Although Kenya's dairy sector has a significant contribution to the national economy, household incomes and food security, the industry faces a number of technical, economic and institutional problems in milk production, processing and marketing (Karanja, 2003).

Dairy farming has geometric benefits ranging from food security, job creation, income generation and foreign exchange earnings and also source of protein to human diet. It also enhances dairy farmers, processors, traders and the entire participants of milk chain distribution. Despite the huge engagement in farming, the smallholder farmers fetch considerably low incomes and are thus unable to meet most of their household needs (BDSP, 2010). This has led to low living standards amongst the smallholder farmers and their dependants. Further, more than half of Kenya's population lives in rural areas where poverty is the most extreme. On this background, it is greatly important to improve the livelihoods of the rural poor. Therefore, the contribution by on-farm diversification of dairy projects to farmers' income needs to be established.

Barrett and Reardon (2000) noted that the core of livelihood models focus on the relationship between assets (capitals), livelihood strategies composed of various activities (livestock production, off-farm employment, informal sector and exchange activities) and to livelihood outcomes (improved income, food security, sustainable use of natural resources, better functioning of social networks and groups and reduced vulnerability) within a mediating environment (DFID, 2001). Furthermore, livelihood outcomes strengthen the five livelihood assets (physical, financial, natural, social and human capitals). Researchers can adopt a simple framework to assess the impact of agricultural technologies on rural livelihoods. For example, livelihood outcomes associated with income changes represent changes in financial capital and if this has been mediated through a new agricultural technology, then it represents the impact of

the technology on the financial capital of rural people. Ashley and Hussein (2000) suggest that, when it comes to impact assessment, it means that changes should be measurable (such as cash and yield) and must be assessed not in their own right but in terms of the contribution they make to livelihoods. Livelihoods approach is used because it is people centered and takes the problems of people, and particularly the poorest, as starting point for analysis and development planning (Ashley and Hussein, 2000; Ellis, 2000; Marsaili, 2006).

Diversifying an existing farm business entails incorporation of alternative enterprises (Mitchell and). Diversification is practiced for purposes of increasing income and food availability (Mahendrarajah et al., 2005). Because land use change is fundamentally a spatial phenomenon, there should be the incorporation of space as an explanatory variable in land use decision-making (Colin, 2010). A key element in this regard relates to the interdependencies between aggregate patterns of land use and the individual choices that give rise to these patterns, where a given land use conversion is determined by the returns or utility generated by that use (Geoghegan & Bockstael, 1996; Colin, 2010). Diversification is an important way of promoting flexibility and countering risk and uncertainty. Normal recurrent and abnormal periodic risks are most easily weathered by those households which have access to two or more economic activities.

According to Hardaker et al., (2004), most of the farm plans intended to maximize expected returns will often be reasonably diversified before risk aversion is considered. Maman et al., (2008) pointed out that farming diversification positively influences income and food security. This is because many households use diversification to avoid income fluctuation. It is therefore necessary to integrate diversification with market development. The new merit of diversifying needs to be considered in terms of the perceived multiple risks (financial, legal, personal, price and market) associated with an alternative enterprise, and considered within the whole portfolio of farm activities, (Mitchell & Marsaili, 2006). Farmers may adopt diversification strategies as a way to reduce the financial risks inherent in their farm business because they (financial risks) increase with higher levels of leverage.

Kenya is among the big producers of milk leading all the east African countries. South Africa has the most efficient production system and produces 2,500 liters/ cow/year compared to 800 liters/cow/year in Uganda, 1,000 liters/cow/year in Tanzania and 1,800 liters/cow/year in Kenya (FAO, 2010). The Kenyan dairy industry can be benchmarked to dairy industries in China, India and Australia. All these countries have a production system similar to the one in Kenya which is low cost because it is based on rain fed pasture production (GOK, 2010). In Kenya, the dairy industry is the single largest agricultural sub-sector, larger than even tea (Muriuki, 2003). It contributes 14 percent of agricultural GDP and 3.5 percent of total GDP

(GOK, 2008). Although Kenya's dairy sector has a significant contribution to the national economy, household incomes and food security, the industry faces a number of technical, economic and institutional problems in milk production, processing and marketing.

Karanja (2002) observed that Kenya's dairy industry is faced by a number of technical, economic and institutional problems in milk production, processing and marketing. Of the 19 registered dairy cooperative societies in Kericho County, four are active, (MOCD, 2011). The societies are not able to procure and supply inputs to the members at competitive prices. Furthermore the cooperatives have not registered any growth over the past five years. The Ministry of Cooperative Development (2012) annual report shows that turnover recorded by the dairy cooperatives in Kericho County in 2011 was kshs 4,194 million, compared to kshs 5535 million in 2010 and Kshs 13953 million in 2005, a 70% decrease from 2005.

According to a study by Tibbs and Yegon (2015) on economic determinants on the performance of dairy co-operative societies established that the most important economic determinant of dairy performance is capital formation which was considered by 85.7% of respondents to affect performance to a high extent; followed by entrepreneurship (67.4%), capacity utilization (67.3%), adoption of technology (63.3%), and competition (53.1%). Bureti is one of the sub-counties in Kericho County. The sub-county is located in 0.50 S and 35.250 E. The sub-county occupies a total area of 955 km^2. Economic activities in the district include: tea growing and processing; dairy farming; and commercial businesses. According to Tetra Pak Eastern Africa (2016), a dairy hub has been established to benefit over 2,000 dairy farmers in a bid to develop the dairy sector value chain and create a more sustainable source of milk in the district. Kokiche division has an estimated population of 90,000 dairy cows with each farmer averaging around three cows on estimated five acres pieces of land. The dairy hub to be implemented in twin phases will see the installation of two 5,000 litres cooling tanks among related infrastructure and fixtures at Cheptalal. Upon completion of the cooling plants, the Kokiche Dairy Company would be able to handle a minimum daily intake of 8,000 litres of milk per day from smallholder dairy farmers in Bureti.

Statement of the Problem

Milk and dairy products forms a vital source of nutrition, livelihoods (food security and poverty alleviation) opportunities for farmers and other stakeholders. Milk is Kenya's most important livestock product at 4,780,620,000 litres, valued at KSh 257.811 billion, translating to about 70% of the total gross valued at KSh 197.018 billion. However, in many farms, milk productivity per animal is low compared to other parts of the world despite the technological advances in animal breeding and value addition. This has created both economic and nutritional challenges while

the demand and value for dairy products is projected to increase in the world. The dairy industry faces a number of technical, economic and institutional problems in milk production, processing and marketing. These constraints affect the ability of the sector to participate and compete in the domestic and regional markets. Small scale farmers, who own one to three animals produce about 80 percent of the milk and hence the need to diversify the dairy sector. According to the Kenya dairy master plan, over 1.8 million households are involved in milk based enterprises but the sector experiences low productivity, low profitability and slow enterprise growth. The small farmer's households continue to be poor and food insecure as the existing dairy enterprises continues to underperform. Bureti sub-county is highly endowed with suitable ecological conditions for dairy production. Despite the huge engagement in farming, the smallholder farmers fetch considerably low incomes and are thus unable to meet most of their household needs. This has led to low living standards amongst of the smallholder farmers and their dependants. The study therefore aims at assessing the contribution of on-farm dairy diversification projects in enhancing the livelihoods of small scale farmers in Bureti sub-county.

THEORETICAL LITERATURE

This section discusses the theories that will guide the study on the contribution of on-farm dairy diversification projects in enhancing livelihoods of small scale farmers. The study will be based on the resource dependency and stakeholder theories.

Resource Dependence Theory

While proposing resource dependency theory (RDT), Pfeffer and Salancik (1978) postulated that organizations depend on multidimensional resources: labor, capital, raw materials among others. Organizations may not be able to come out with countervailing initiatives for all these multiple resources. Thus, organizations should move through the principle of criticality and scarcity. Hence, resource dependence theory has implications regarding the optimal divisional structure of organizations at different levels and many other aspects of organizational strategy. The theory is based upon how the external resources of organizations affect the behavior of the organization. This is true for diversification of on-farm dairy projects which requires resources or investments to implement. Moreover, organizations are dependent on resources that ultimately originate from the environment which also contains other organizations. In line with this study, small scale dairy farmers' need resources to diversify their dairy farming projects and the resources comes from different organizations. Resources are a basis of power; legally independent organizations can therefore be dependent on each other (Chapman et al. 2011).

Resources are inherently uncertain and this is true with changing trends of financial uncertainties. There is need to lean towards other theories of uncertainties. According to this theory, organization depends on resources for their survival; therefore, for diversification projects to achieve sustainability, resources are indispensable. In this study, dairy funding, milk production sustainability, technology adoption and production risk control are all resource dependent and interdependent in nature. Resource uncertainties affect the size, speed of implementation and sustainability of dairy diversification projects. Sustainable milk production, technology adoption and production risk control have been found to consistently rely on regular investments to meaningfully contribute to the livelihoods of small holder dairy farmers. This theory will help explain the disparities in the implementation of each of the aforementioned factors and their influence on the contribution of on-farm dairy diversification projects.

According to Freeman (1984), a stakeholder is any group or individual who can be affected or is affected by the achievement of the organization or project's objectives. Project stakeholders are individuals and/or organizations who actively participate in the project or whose interests are likely to be affected by the execution of the project (PMI, 2004). In addition, Chinyio and Olomolaiye (2010) stated that stakeholders could affect an organization's functioning, goals, development, and even survival. Stakeholders could be beneficial when they facilitate the realization of the projects' goals and may be antagonistic when they oppose the projects' mission. It is further opined that stakeholders are crucial to the sustainability of projects since their non-commitment to continuously support the objectives of the project may lead failure. According to Khwaja (2004), participation is attained through collaborative or joint involvement of project beneficiaries and the implementing agencies. The real value of participation stems from the finding that mobilizing the entire stakeholders, rather than engaging people on an individualized basis, leads to more effective results (Braithwaite et al., 1994). Simply said, change "... is more likely to be successful and permanent when the people it affects are involved in initiating and promoting it" (Thompson et al, 1990). The stakeholder theory is also management concept because it does not simply describe existing situations or predict cause-effect relationships; it also recommends attitudes, structures, and practices that, taken together, constitute stakeholder management. Stakeholder management requires simultaneous attention to the legitimate interests of all appropriate stakeholders during decision making. The success of on-farm dairy diversification projects in enhancing the livelihoods of smallholder farmers requires prudent management of stakeholders. They comprise of dairy farmers, government agencies, private sectors and financial institutions. All these stakeholders should work hand in hand to ensure on-farm dairy diversification projects are successful.

EMPIRICAL REVIEW

Influence of Dairy Funding on Enhancing Livelihoods

The Kenyan government over the past decade has recognized the challenges facing the dairy industry. With the support from the private sector and donor agencies, various interventions have been spearheaded to improve the competitiveness of smallholder dairy farmers especially on access to credit facilities. Credit access by smallholder dairy farmers is not only affected by interest rate but by all characteristics of credit. Before market liberalization in Kenya, formal agricultural credit was provided at subsidized rates through the Agricultural Finance Corporation (AFC). However, this parastatal experienced difficulties in recovering loan advances and had to stop lending at subsidized rates. Even after experiencing challenges, AFC lending rates have remained lower than commercial rates and are more stable. Although banks are legally required to lend between 17% and 20% of their loan portfolio to the agriculture sector, the local banking system has been conservative in lending to agriculture (Backlund, 2009). To build the dairy industry's competitive position, it is important to enhance financial accessibility by the smallholder farmers.

In developed countries, dairy production is mostly done by large scale enterprises with competitive management systems and high uptake of technology and big capital outlay while in the developing countries it is largely by small scale farmers with minimum management and technical skills, limited access to capital and low access to information. This has resulted to disparities in milk production levels in developing and developed economies (Muthami, 2011).According to IFAD (2010), the systematic and prudent financing of smallholder agriculture has been and continues to be a difficult goal in Kenya in spite of remarkable progress in the microfinance over the past twenty years. Agriculture, with its non-uniform cash flows, rural bias, poorly capitalized and widely dispersed producers, seasonal cash flows, price and market risks differs substantially from businesses conventionally supported by traditional finance and microfinance.

The Kenya Dairy Board (KDB) is the lead parastatal among the dairy regulatory institutions. It has however been observed that over the years, KDB, like other regulatory institutions, concentrated its effort in policing the activities of milk marketing (Mburu, 2002). KDB is mandated to efficiently and sustainably develop, promote and regulate the dairy industry and create an enabling environment for increased private sector entrepreneurship in milk production, processing and marketing (Ngurare, 2003). According to SNV (2013), dairy industry policies affect the business enabling environment. Some policies are counter-productive to the growth and commercialization of the dairy sector, e.g. VAT on liquid processed milk. KMDP engages with policy and opinion makers to identify or address policies constraining the growth and

competitiveness of the sector. Examples of this are fiscal policies regarding tax exemptions for dairy equipment and liquid processed milk and regulation of the raw milk market. Credit access is not only affected by interest rate but by all characteristics of credit.

In Kenya , in order for an individual to score a loan, collateral are essential and deemed secure while it can be sold in case of default or continuous disrespect of repayment agreement. Commercial banks require that a loan applicant be having land and property tittles, log book, infrastructure and books of account. Small scale dairy farmers in Bureti too face such challenges. While it is possible for small holder dairy farmer to access loans, the package is significantly small making it harder to experience substantial profit margin that can be ploughed back or reinvested. In essence, such restrictions are meant to weed out poor small dairy holders and accommodate the well off farmers (Lange, 2012).

Influence of Milk Production Sustainability on Enhancing Livelihoods

The quantity of milk produced in a year by an animal varies enormously according to breed, feed and management practices (Macaskill, 2010). The world milk production after stagnating in 2009 rebounded in 2010 and was expected to grow initially in excess of 2% annually for the next three years, causing prices to decline. As prices adjusted downward, the growth in milk production after 2013 was expected to be less vigorous (Books, 2010). Upgraded (crossbred) dairy cow breeds are kept under the zero grazing system or under the semi-zero-grazing systems (Halberg, 2006). The production systems are influenced by the agro climatic characteristics of the area, land productivity potential and prevalence of animal diseases. Both farmers in small scale and large scale practices are not utilizing the potential in dairy farming to achieve maximum profits that can transform their lives (Knechtges, 2011).

Dairy farmers face diverse challenges ranging from lack of proper management skills of rearing dairy cows, proper feeding procedures, poor infrastructure, high cost of dairy feed meals and lack of stable for their milk. Many of the dairy farmers embrace paddocking and a few have partial zero grazing which do not guarantee the dairy animal sufficient food to enable it produce to its full milk potential, a maximum of 15 to 25 litres of milk per day (Backlund, 2009). Kenya has potential of leading in milk production but there are still many challenges. The agricultural development corporation (ADC) parastatal was mandated to research on quality breeds but failed to avail high productive and disease resistant breeds. While the breeds present at ADC are expensive and the bureaucracy involved purchasing a cow or heifer is discouraging, farmers opt to go for their locally bred animals (Moran, 2009). The world average of 2,300 kg/year of milk per cow is somewhat meaningless because it is influenced heavily by the large numbers of poor-yielding animals in less developed countries across the globe. In many developed

countries, yields are typically 4,000–5,000 kg/head and exceptionally reach 6,000–8,000kg/head particular intensively managed enterprises.

In such systems, cows will be selected on the basis of yield and the calving. According to Kardasian (2012), climate change, however, is expected to negatively impact the industry in the future. Climatic events such as rising temperatures and atmospheric carbon dioxide concentrations will change the prices of dairy farms' inputs, including feed, fuel, and electricity. Higher temperatures additionally cause heat stress for dairy cows, leading to a reduction in milk yields. While climate change may negatively affect dairy farms, it also helps dairy farmers plan how to mitigate by calculating impacts specific to their farms, allowing them to understand the impacts of climate change and plan for the future (Roussel, 2006). Feed comprises almost 50% of a dairy farmer's budget. While climate change is expected to decrease the yield of corn, causing corn prices to increase, alfalfa yields are expected to show a moderate improvement (Backlund, 2009). Additionally, climate change is expected to increase fuel and electricity costs (Peter, 2014).

Influence of Technology Adoption on Enhancing Livelihoods

Dairy operations today are characterized by narrower profit margins than in the past largely because of reduced government involvement in regulating agricultural commodity prices. According to Robinson (2012), small changes in production or efficiency can have a major impact on profitability. The resulting competition growth has intensified the drive for efficiency resulting in increased emphasis on business, financial management and technology adoption. Furthermore, the decision making landscape for a dairy manager has changed dramatically with increased emphasis on consumer protection, continuous quality assurance, natural foods, pathogen-free food, reduction of the use of medical treatments, and increased concern for the care of animals (Robinson, 2012). Artificial Insemination (AI) is the second most common technology of breeding livestock.

Productivity of US dairy farms has increased rapidly over the past 50 years: from 1961 to 2011, milk produced per cow increased 296%, according to US Department of Agriculture (USDA) Statistical Reporting Service and USDA National Agricultural Statistics Service statistics. 14% increased dairy productivity is attributed to improved genetics, advanced technology, and better management practices, including advanced breeding innovations. Modern breeding technologies such as artificial insemination (AI), embryo transplants (ET), and sexed semen (SS) have been replacing conventional natural breeding for a number of years, estimate that US dairy farms using genetic selection and breeding programs such as ET and AI increased from 64.3% in 2000 to 81.5% in 2005.

Breeding technology affects herd genetics and reproductive performance, influencing farm economics and productivity (Roussel, 2006). Roussel posited breeding technologies were the most significant factor contributing to farm livestock productivity since the 1940s. Artificial insemination (AI) is one of the most effective tools available to cattle producers to improve productivity and profitability of their cattle operation. Artificial insemination has been commercially available for more than 65 years and utilized very effectively in the dairy industry. However, it is underutilized in the U.S. beef herds. As a point of comparison, about 66% of the nation's dairy cows are bred AI (Books, 2010).

Milk cooling technologies have enhanced the shelf life of milk. Fresh raw milk is cooled to 4 degrees celcius to extend its shelf-life (freshness). Hence, if the time between milk reception and processing is 2 to 3 days, the storage temperature should be kept between 2° C to 5° C for minimum effect on keeping quality of milk purchased milk from famers at a fair price (Backlund, 2009). Also, improved quality of milk can be supplied to the main dairy plant for quality products processing ready for both domestic and export markets (Knechtges, 2011). Extension services, which provide support for the dairy farmers geared towards improving management, feeding, fertility and veterinary care are crucial to sustainable small scale dairy farming.

Studies have shown that farmer technology trait, farm trait, economic, characteristics and institutional factors are common and determines farmers decision to either adopt or abandon new agricultural technologies (Macaskill, 2010). Education and training increase propels information flow and exposes a wide view of knowledge to farmer's thus promoting adoption of better technologies. United States for instance uses trained extension officers to provide various services to farmers. Services ranges from advisory services transfer of technology and human capacity building.

Influence of Production Risk Control on Enhancing Livelihoods

The dairy sub-sector in Kenya accounts for 14% of the agricultural GDP and 3.5% of national GDP. Smallholder dairy farmers' account for approximately 75% of the total milk produced in the country (Dairy Board, 2011). In addition, the informal sector is the dominant force in milk trading in Kenya. At least 800,000 smallholder farmers in Kenya depend on dairy farming for their livelihoods. As a result, dairy production improves household nutrition and provides extra income. In addition to family labor, dairy farming generates jobs in wage labor and mobile milk trading for a further 365,000 people. These jobs benefit the poorest people in urban and rural areas (IFAD, 2013). Therefore, farm diversification been is considered as one of the mitigation

measures against risks related to agriculture aimed at reducing variations in farm income, (Mahendrarajah, 2005).

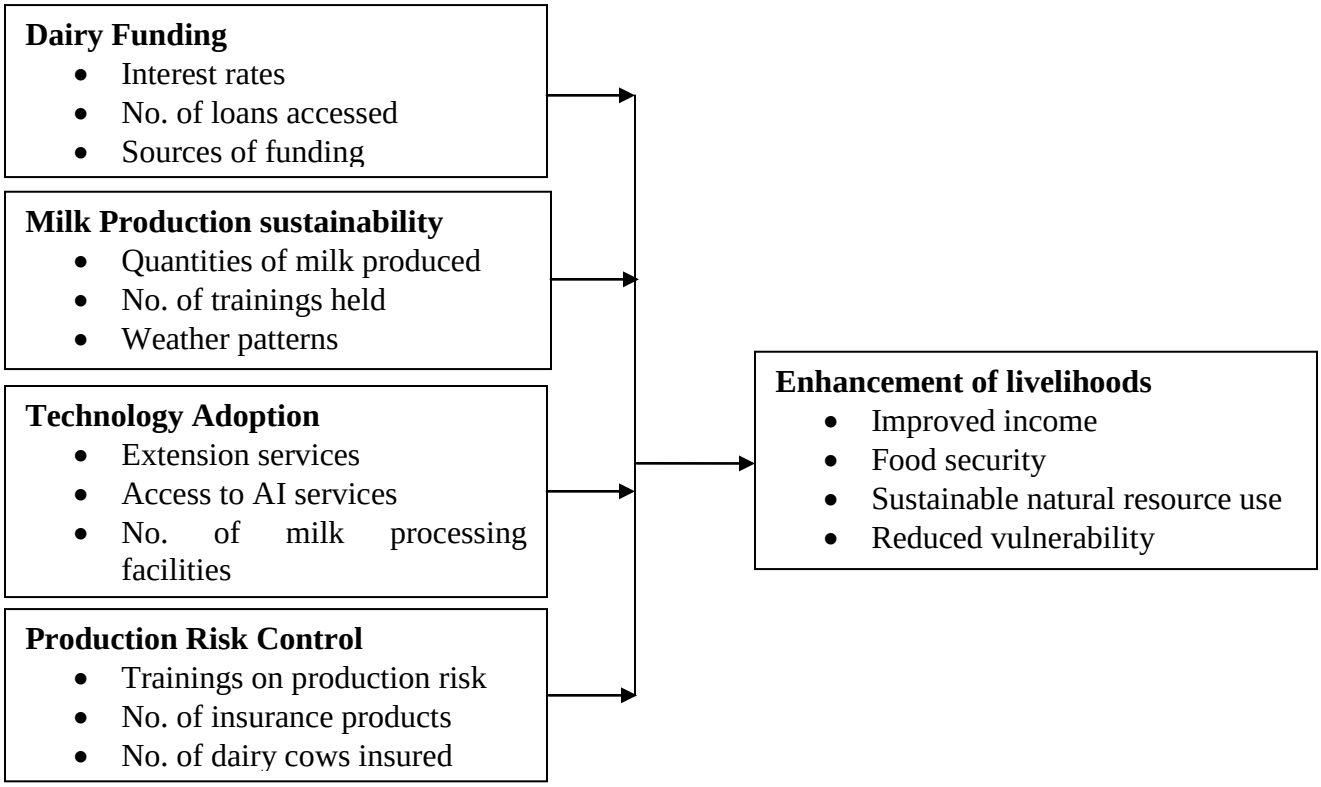
The farm holding average in smallholder sub-sector is approximately 0.27 ha and the population pressure in the tea growing sub-counties like Bureti is quite high compared with those without the enterprise. This robust population growth in the tea growing regions translates into continued subdivision of land to school leavers who cannot get alternative employment in other sectors of the economy (Kavoi et.al, 2001). This therefore calls for different approaches on how to practice agriculture given the declining land size per capita. About 60 percent of total milk production in Kenya takes place in less than 10 percent of the country's landmass (Omore et al., 1999). In addition, the dairy sector has performed poorly over the years due to bad policies that left it vulnerable to vagaries of weather and production risks.

For instance, the industry is today caught in vicious cycle in which production fluctuates sharply during certain seasons of the year depending on the prevailing weather conditions. Small scale dairy production systems range from stall-fed cut-and-carry systems, supplemented with commercial concentrate, to free grazing on unimproved natural pastures in the more marginal areas. Upgraded (crossbred) dairy cow breeds are kept under the zero grazing system or under the semi-zero-grazing systems (Halberg, 2006). The production systems are influenced by the agro climatic characteristics of the area, land productivity potential and prevalence of animal diseases. Production risk occurs due to elements such as weather and disease. In harsh climates, weather-induced production risk is greater than price risk (Bhende &Venkataram, 2004). The onset of the dry season towards the start of every new year as well as the wet and cold season around the middle of the year, heavily affect production and pricing of milk and other dairy products. Moreover, the country faced a severe drought in 2009 causing scarcity of animal feed and water which led to a further drop in milk production.

Disease can be reduced through the use of inputs such as herbicide, pesticide, vaccinations, wormers, and dips among others. Animal insurance aids in the reduction of production risk. In some countries, crop and animal insurance aids are mandatory. Blank and MacDonald (2006) observed that there was a greater incidence of diversification where there was no crop or animal insurance and that farmers with lower off-farm incomes were more likely to insure. It appears that diversification and insurance are not substitutes, but both reduce risks. Unfortunately, the performance of public animal insurance companies has been poor in both most developed countries (MDCs) and least developed countries (LDCs). This is largely because the risks against which producers are being insured are open to problems such as natural hazard. Insurance may be undermined by government aid during disasters such as drought or flooding (Hardaker *et al*., 2007).

Dairy operations today are characterized by narrower profit margins than in the past largely because of reduced government involvement in regulating agricultural commodity prices. According to Robinson (2012), small changes in production or efficiency can have a major impact on profitability. The resulting competition growth has intensified the drive for efficiency resulting in increased emphasis on business, financial management and technology adoption.

Figure 1. Conceptual framework



Summary of the Reviewed literature

According to IFAD (2010), the systematic and prudent financing of smallholder agriculture has been and continues to be a difficult goal in Kenya in spite of remarkable progress in the microfinance over the past twenty years. Agriculture, with its non-uniform cash flows, rural bias, poorly capitalized and widely dispersed producers, seasonal cash flows, price and market risks differs substantially from businesses conventionally supported by traditional finance and microfinance. The quantity of milk produced in a year by an animal varies enormously according to breed, feed and management practices (Macaskill, 2010). The world milk production after stagnating in 2009 rebounded in 2010 and is expected to grow initially in excess of 2% annually for the next three years, causing prices to decline. As prices adjust downward, the growth in

milk production after 2013 is expected to be less vigorous (Books, 2010). Upgraded (crossbred) dairy cow breeds are kept under the zero grazing system or under the semi-zero-grazing systems (Halberg, 2006).

The resulting competition growth has intensified the drive for efficiency resulting in increased emphasis on business, financial management and technology adoption. Furthermore, the decision making landscape for a dairy manager has changed dramatically with increased emphasis on consumer protection, continuous quality assurance, natural foods, pathogen-free food, reduction of the use of medical treatments, and increased concern for the care of animals (Robinson, 2012). Therefore, farm diversification been is considered as one of the mitigation measures against risks related to agriculture aimed at reducing variations in farm income, (Mahendrarajah, 2005). The farm holding average in smallholder sub-sector is approximately 0.27 ha and the population pressure in the tea growing sub-counties like Bureti is quite high compared with those without the enterprise.

Research Gaps

Milk is Kenya's most important livestock product at 4,780,620,000 litres, valued at KSh 257.811 billion, translating to about 70% of the total gross valued at KSh 197.018 billion. However, in many farms, milk productivity per animal is low compared to other parts of the world despite the technological advances in animal breeding and value addition. This has created both economic and nutritional challenges while the demand and value for dairy products is projected to increase in the world.

The dairy industry faces a number of technical, economic and institutional problems in milk production, processing and marketing. These constraints affect the ability of the sector to participate and compete in the domestic and regional markets. Small scale farmers, who own one to three animals produce about 80 percent of the milk and hence the need to diversify the dairy sector. The small farmer's households continue to be poor and food insecure as the existing dairy enterprises continues to underperform.

Bureti sub-county is highly endowed with suitable ecological conditions for dairy production. Despite the huge engagement in farming, the smallholder farmers fetch considerably low incomes and are thus unable to meet most of their household needs (BDSP, 2005-2010). This has led to low living standards amongst of the smallholder farmers and their dependants. The study therefore aims at assessing the contribution of on-farm dairy diversification projects in enhancing the livelihoods of small scale farmers in Bureti sub-county, Kenya.

METHODOLOGY

Research Design

The study employed a descriptive research design. This is because it permitted the collection of data through questionnaires administered to a sample quickly, efficiently and accurately (Oso & Onen, 2005). The data collected by this design was used to suggest reasons for particular relationships between variables (Saunders &Thorn hill, 2007).

Target Population

The study targeted a population of 280 respondents from 14 dairy farmer groups each with an estimated number of 20 members. Bureti sub-county has 7 Wards and therefore 2 groups of dairy farmers were selected randomly from each Ward making a total of 14 groups.

Sample Frame

According to Silverman (2005), the sample should be large enough to allow the researcher to make inferences of the entire population. The sample frame for this study comprised of 280 smallholder dairy farmers. Further, sampling must be so large that it allows a researcher to feel confident about the sample representativeness and it allows the researcher to make inferences of the sampling frame and the entire population (Silverman, 2005).

Sample Size and Sampling Procedure

The Nassiuma (2000) formula was used to determine the sample size for the study.

$$n = \frac{NC^2}{C^2 + (N-1)e^2}$$ .....Equation (1)

Where

n = sample size;

N = population size;

C = coefficient of variation which is 50%

e = error margin which is 0.05.

$$n = \frac{280\ (0.5)^2}{0.5^2 + (280-1)0.05^2}$$

$$n = 74$$

Simple random sampling was used to select a sample size of 74 respondents for the study.

Data Collection Instruments

The study used a structured questionnaire to collect data from the sampled respondents. Questionnaires are research instruments used to collect information geared towards addressing specific objectives (Kombo et al., 2002). The questionnaires are cost effective, time saving and upholds individual opinions with minimal interference from the researcher (Mugenda & Mugenda 2003). The use of questionnaires was justified by the fact that it is affordable and an effective way of collecting information from a population in a short time and at a reduced cost. The questionnaires were also easier coding and analysis of data collected.

Data Collection Procedure

Data collection as defined by Kombo et al. (2002) is the process of gathering specific information aimed at proving or refuting some facts. Prior to issuing of the questionnaire, the necessary permits were obtained from the relevant authorities for ethical considerations. The questionnaires were self-administered using drop-and-pick-later method. The respondents were given one week to fill before follow up was made to collect the questionnaires.

Pilot Testing

Prior to conducting the main research, a pilot study was conducted in some smallholder dairy farming projects to test the reliability and validity of the research instrument. Validity is the degree to which an instrument measures what is supposed to measure (Kothari, 2004) while reliability refers to a measure of the degree to which research instruments yield consistent results (Mugenda & Mugenda, 2003). This was done by pre-testing the questionnaire. The pilot study will purposely be used to test for validity and reliability of the research instrument. Validity test measures the ability of the research instruments to measure what it is intended to (Kathuri, 1993). A content validity test was conducted to ensure all indicators to be measured were adequately represented.

According to Sukaran (2010), content validity is a function of how well the dimensions or elements of a concept have been captured. Reliability test on the other hand looks at the ability of research instruments to give consistent results over and over again (Kombo et al., 2002). Mugenda & Mugenda, (2003) recommended a 10% of the target population to be considered as a sample size in a pilot study. According to Kombo & Tromp (2006), reliability is the extent to which results are consistent overtime. Reliability of the research instrument was calculated using Cronbach's coefficient alpha for either even or uneven items based on the order of number of arrangement of the questionnaire items. A correlation coefficient greater or equal to 0.7 was accepted (George & Mallery, 2003).

Pilot Study Results

A pilot study was conducted to test the reliability and validity of the questionnaire. A Sample size of 7 respondents, (10% of the study sample) was selected from Bureti sub-county and administered with the questionnaires. The response rate was 100%. The Cronbach's Alpha test was conducted and all the four variables gave Cronbach's Alpha values greater than 0.7 as shown in Table 1. According to George and Mallery (2003), Cronbach correlation coefficients greater or equal to 0.7 are acceptable. Based on the results, all the variables were accepted for the study. The results of the pilot study were not be included in the final data analysis.

Table 1: Reliability Test Results

Variable	Number of Test Items	Cronbach's Alpha Value
Dairy funding	5	.895
Milk production sustainability	5	.893
Technology adoption	5	.884
Production risk control	5	.890

Data Processing and Analysis

Data analysis refers to examining what has been collected in a survey or experiment and marking deductions and inferences (Kombo et al., 2002). The data collected was coded and analyzed using the Statistical Package for Social Sciences (SPSS version 23) tool. Descriptive analysis and inferential analysis was conducted. The regression model tested is shown below:

$Yi = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon$ ……Equation (2)

Y_1 represents Enhancement of livelihoods of smallholder dairy farmers

X_1 = Dairy funding; X_2 = Milk production sustainability; X_3 = Technology adoption; X_4 = Production risk control and ε = representing the error term with a mean of zero. β 1, β 2, and β 3 are the net change in Y.

FINDINGS AND DISCUSSIONS

Response Rate

The study targeted a sample size of 74 participants out of which 68 questionnaires were completely well filled and used for data analysis. This yielded a response rate of 91.9%. According to Mugenda and Mugenda (2003), any response rate of over 50% is sufficient to facilitate statistical analysis.

Analysis of Demographic Characteristics of the Population

The study sought to establish the population characteristics of the respondents on gender distribution, age categories, level of education, experience in dairy farming projects and the quantity of milk produced from the dairy projects. Analysis of population characteristics are important in enabling the generalization of the collected data (Warren & Roberts, 2002).

Gender Distribution of the Participants

The study analyzed the gender distribution of the participants and the results are as shown in Table 2.

Table 2: Gender Distribution of the Participants

Gender	Frequency	Percent (%)
Male	30	44.1
Female	38	55.9
Total	**68**	**100.0**

From the findings in Table 2, majority of the participants were female (55.9%) followed by the male (44.1%). The findings show that there were more female dairy farmers than male farmers among the participants. This implies that more women are involved in dairy farming enterprises compared to men. This is because most women are involved in dairy farming the rural areas of Kericho County while men prefer venturing into other enterprises or employment to provide for their families.

Age of the Participants

In this section, the study analyzed the age categories of the participants and the results are illustrated in Table 3.

Table 3: Age of the Participants

Age	Frequency	Percent (%)
18-25 years	10	14.7
26-33 years	12	17.6
34-41 years	31	45.6
Above 42 years	15	22.1
Total	**68**	**100.0**

The study assessed the age distribution of the sample and majority of the participants (45.6%) were aged between 34 and 41 years followed by those aged above 42 years. Those aged between 18 to 25 years were the least (14.7%). The age distribution matches the expectation of the researcher given the study sought to get in-depth information on dairy diversification projects in Bureti sub-county. Results implies that majority of the participants aged between 34 and 41 years have established their homes and own land to enable them conduct dairy farming.

Education Level of the Participants

This section analyzes the levels of education the participants had attained and the results are shown in Table 4.

Table 4: Education Level of the Participants

Level	Frequency	Percent (%)
Primary	21	30.9
Secondary	24	35.3
College	19	27.9
University	4	5.9
Total	**68**	**100.0**

The study also sought to assess the education levels of the participants and from the findings in Table 4, majority of the respondents (35.3%) had attained secondary level, 30.9% primary education while 27.9% had attained college level of education. 5.9% had attained university level of education. Findings show the respondents were capable of comprehending and answering questions as majority had attained secondary school education levels and above.

Length of Experience in Dairy Farming

This section illustrates the length of experience in terms of years the participants have been engaged in dairy farming and the results are in Table 5.

Table 5: Length of Experience in Dairy Farming

Duration	Frequency	Percent (%)
Less than 1 year	6	8.8
1-5 years	11	16.2
5-10 years	18	26.5
Above 10 years	33	48.5
Total	**68**	**100.0**

The researcher in addition examined the length of experience in years the participants had been involved in dairy farming activities. The results in Table 5 shows that the majority of the participants (48.5%) had conducted dairy farming for over 10 years while 8.8% had conducted dairy farming for less than one year and 26.5% had done dairy farming for 5 to 10 years. These findings indicates that majority of the participants had conducted dairy farming for over 5 years and therefore were better placed to provide very reliable information on on-farm dairy diversification projects in Bureti sub-county. Therefore, the participants were competent to adequately respond to the research questions.

Quantity of Milk Production

This section analyzes the quantities of milk the participants obtain from their dairy projects as shown in Table 6.

Table 6: Quantity of Milk Production

Quantity	Frequency	Percent (%)
1-5 litres	18	26.5
5-10 litres	29	42.7
10-15 litres	7	10.3
15-20 litres	9	13.2
Over 20 litres	5	7.5
Total	**68**	**100.0**

The study further examined the quantity of milk the participants obtained from their dairy farming projects. As shown in Table 4.5, majority of the participants obtained 5 to 10 litres per day while 7.5% obtained over 20 litres of milk per day. From the findings, it can also be inferred that most of the participants obtained between 1 and 10 litres of milk per day. The findings are consistent to those of Backlund (2009) who posited that many dairy farmers who embrace paddocking rearing and a few who have partial zero grazing which do not guarantee the dairy animal sufficient food to enable it produce to its full milk potential, a maximum of 15 to 25 litres of milk are produced per day.

Descriptive Analysis

Descriptive analysis focuses on describing the basic feature of the data in a given study (Cooper & Schindler, 2013). In this section, descriptive analysis was used to summarize data regarding dairy funding, milk production sustainability, technology adoption and production risk

control and how they influence on-farm dairy diversification projects and enhancing of livelihoods of smallholder dairy farmers.

Analysis of Dairy Funding

Table 7: Analysis of Dairy Funding

Statements on Dairy Funding	N	SA	A	N	D	SD	Mean	S.D
1. Insufficient dairy funding affects contribution of on-farm dairy diversification projects	68	58.8%	19.1%	5.9%	7.4%	8.8%	4.65	.487
2. Loan collateral needed by financial institutions inhibit access to funds by smallholder dairy farmers	68	17.6%	54.4%	10.3%	8.8%	8.9%	4.09	.668
3. Interest rates in commercial banks are high and unaffordable by dairy farmers	68	20.6%	52.9%	13.2%	7.4%	5.9%	4.30	.635
4. Most farmers borrow finances from informal groups for their dairy projects	68	17.6%	50.0%	14.7%	11.8%	5.9%	4.13	.694
5. The county government of Kericho provides financing for smallholder dairy farmers	68	22.1%	51.5%	10.3%	11.8%	4.3%	4.04	.976

The first statement sought to establish how insufficient dairy funding affects on-farm dairy diversification projects in enhancing the livelihoods of smallholder farmers. The findings in Table 7 indicates that majority of the participants were strongly in agreement with a mean of 4.65 and standard deviation of 0.487. The second statement asked the participants whether loan collateral needed by financial institutions inhibit access to funds by smallholder dairy farmers. The respondents agreed with the statement with a mean of 4.09 and standard deviation of 0.668. Further analysis on whether interest rates in commercial banks are high and unaffordable by dairy farmers revealed that majority of the respondents was in agreement with a mean of 4.30 and standard deviation of 0.635. On whether most farmers borrow finances from informal groups for their dairy projects, the study established that a majority of the participants were in agreement with a mean of 4.13 and standard deviation of 0.694. The study also sought to ascertain whether the county government of Kericho provides financing for smallholder dairy

farmers. A mean of 4.04 and standard deviation of 0.976 indicates that the participants were in agreement. All the standard deviation for all the statements on dairy funding were less than 1 indicating that the participants were cohesive in their responses towards all the statements on dairy funding.

Analysis of Milk Production Sustainability

This section analyzes milk production sustainability and its influence on enhancing the livelihoods of smallholder farmers. The study also sought to assess the influence of milk production sustainability on on-farm dairy diversification projects in enhancing the livelihoods of smallholder farmers in Table 8.

Table 8: Analysis of Milk Production Sustainability

Statements on Milk Production Sustainability	N	SA	A	N	D	SD	Mean	S.D
6. Lack of basic skills on dairy farming affects milk Production sustainability	68	54.4%	19.1%	14.8%	8.8%	2.9%	4.91	.487
7. Lack of specific and relevant skills hamper milk production of smallholder dairy farming projects	68	16.2%	55.9%	16.2%	7.4%	4.3%	4.35	.487
8. Low level of education of farmers affect milk production among smallholder dairy farming projects	68	14.7%	57.4%	13.2%	10.3%	4.4%	4.52	.593
9. Limited knowledge of funding sources constraint milk production by smallholder dairy farming projects	68	26.5%	48.5%	11.8%	5.9%	7.3%	4.39	.583
10. Unpredictable weather conditions affect smallholder dairy farming projects in terms of milk output/production	68	27.9%	47.1%	17.6%	5.9%	1.5%	4.35	.775

The first statement asked the participants on whether lack of basic skills on dairy farming affects milk Production sustainability. Majority of the participants strongly agreed with a mean of 4.91 and standard deviation of 0.487. The second statement assessed whether lack of specific and

relevant skills hamper milk production of smallholder dairy farming projects. Majority of the participants agreed with a mean of 4.35 and standard deviation of 0.487 with the statement on lack of skills. The third statement asked the participants whether low level of education of farmers affect milk production among smallholder dairy farming projects. The participants strongly agreed with a mean of 4.52 and standard deviation of 0.593.

The study further assessed whether limited knowledge of funding sources constraint milk production by smallholder dairy farming projects. The respondents were in agreement that limited knowledge indeed is a constraint with a mean of 4.39 and standard deviation of 0.583. Moreover, the study sought to determine whether unpredictable weather conditions affect smallholder dairy farming projects in terms of milk output/production. From the findings, majority of the participants agreed with a mean of 4.35 and standard deviation of 0.775.

Analysis of Technology Adoption

This section analyzes technology adoption and its influence on enhancing the livelihoods of smallholder farmers. The study asked the participants to respond to various statements on technology adoption and its effect on on-farm diversification dairy projects in Table 9.

Table 9: Analysis of Technology Adoption

Statements on Technology Adoption	N	SA	A	N	D	SD	Mean	S.D
11. Lack of enough livestock extension services and training affects smallholder dairy farming activities	68	25.0%	50.0%	19.1%	1.5%	4.4%	4.39	.783
12. Farmers have access to AI services and other breeding services	68	17.6%	26.5%	44.1%	4.4%	7.4%	3.57	1.037
13. There are enough milk cooling equipment and collection centres	68	14.7%	10.3%	47.1%	14.7%	13.2%	3.26	1.176
14. Farmers are trained on new technologies for feeding dairy cows	68	11.8%	14.7%	50.0%	16.2%	7.3%	3.43	1.080
15. The farmers have access to milk processing facilities at the local level to ensure milk is not spoiled	68	13.2%	17.6%	54.4%	7.4%	7.4%	3.39	1.158

The first statement asked the participants whether lack of enough livestock extension services and training affects smallholder dairy farming activities. A mean of 4.39 and standard deviation of revealed that majority of the participants were in agreement. The second statement sought to determine if farmers have access to AI (Artificial insemination) services and other breeding services and majority of the participants were in agreement with a mean of 3.57. A standard deviation of 1.037 indicates that the participants had divergent views in their responses to the statement. The third statement sought to establish if there were enough milk cooling equipments and collection centres. The findings show that majority of the participants were neutral with a mean of 3.26 and a standard deviation of 1.176. The fourth statement sought to find out if farmers are trained on new technologies for feeding dairy cows and majority of the participants were neutral in their responses with a mean of 3.43 and standard deviation of 1.080 showing that the participants were relatively cohesive in their responses. The participants were further neutral that the farmers have access to milk processing facilities at the local level to ensure milk is not spoiled with a mean of 3.39 and standard deviation of 1.158.

Analysis of Production Risk Control

This section analyzes production risk control and its influence on enhancing the livelihoods of smallholder farmers. The study sought to establish whether smallholder dairy farmers are often trained on production risks.

Table 10: Analysis of Production Risk Control

Analysis of Production Risk Control	N	SA	A	N	D	SD	Mean	S.D
16. Smallholder dairy farmers are trained often trained on production risks	68	8.8%	17.6%	20.6%	45.6%	7.4%	2.83	1.749
17. The farmers have insured their dairy animals against diseases, death or theft	68	13.2%	16.2%	14.7%	52.9%	3.0%	2.39	.1.305
18. The insurance companies are available and trains farmers on insurance policies for their dairy activities	68	5.9%	20.6%	17.6%	51.5%	4.4%	2.22	1.473
19. The insurance products and premiums in the market are affordable	68	7.4%	14.7%	17.6%	55.9%	4.4%	2.36	1.293
20. The government provides animal vaccinations and treatments for the farmers	68	11.8%	7.4%	45.6%	20.6%	14.6%	2.81	1.517

Majority of the participants disagreed with a mean of 2.83 and standard deviation of 1.749 in Table 10. The participant further disagreed that the farmers have insured their dairy animals against diseases, death or theft, insurance companies are available and trains farmers on insurance policies for their dairy activities and that the insurance products and premiums in the market are affordable with means of 2.39, 2.22 and 2.36. The responses did not vary from the means by 1.305, 1.473 and 1.293 standard deviations respectively. On whether the government provides animal vaccinations and treatments for the farmers, majority of the participants were neutral with a mean of 2.81 and standard deviation of 1.517. The findings indicate that majority of the participants were either neutral or disagreed with the statements on production risk control. This has a great impact on on-farm dairy diversification projects in enhancing the livelihoods of the smallholder farmers.

Analysis of Livelihoods of Smallholder Farmers

This section analyzes the livelihoods of smallholder farmers.

Table 11: Analysis of Livelihoods of Smallholder Farmers

Statements on Livelihoods	N	SA	A	N	D	SD	Mean	S.D
21. Funding availability enhances livelihoods for smallholder dairy farmers	68	55.9%	17.6%	14.7%	4.4%	7.4%	4.61	.656
22. Insuring dairy animals enhances livelihoods for smallholder dairy farmers	68	22.1%	51.5%	19.1%	4.4%	2.9%	4.22	.736
23. Adoption of dairy technologies enhances livelihoods for smallholder dairy farmers	68	14.7%	50.0%	19.1%	7.4%	8.8%	4.26	.752
24. Sustainable milk production enhances livelihoods for smallholder dairy farmers	68	23.5%	48.5%	10.3%	11.8%	5.9%	4.30	.635
25. Funding availability enhances livelihoods for smallholder dairy farmers	68	57.4%	29.4%	8.8%	2.9%	1.5%	4.56	.517

The study further wanted to assess the livelihoods of smallholder farmers and the first statement sought to establish whether funding availability enhances livelihoods for smallholder dairy farmers. In Table 11, a mean of 4.61 and standard deviation of 0.456 reveals that majority of the

participants were strongly in agreement. In addition, the study sought to find out if insuring dairy animals enhances livelihoods for smallholder dairy farmers and majority of the participants were in agreement with a mean of 4.22 and standard deviation of 0.736. Moreover, the study asked participants whether adoption of dairy technologies enhances livelihoods for smallholder dairy farmers. A mean of 4.26 and standard deviation 0.752 indicates that majority of the participants were in agreement. The study further assessed whether sustainable milk production enhances livelihoods for smallholder dairy farmers and the findings revealed that the participants were in agreement with mean of 4.30 and standard deviation of 0.635. Moreover, the study sought to establish whether funding availability enhances livelihoods for smallholder dairy farmers. Majority of the participants were strongly in agreement with a mean of 4.56 and standard deviation of 0.517.

Inferential Analysis

Relationship between Dairy Funding and Enhancement of Livelihoods

This section analyzes the relationships between dairy funding and the enhancement of livelihoods of smallholder farmers.

Table 12: Relationship between Dairy Funding and Enhancement of Livelihoods

		Dairy Funding
Enhancement of Livelihoods	Pearson Correlation	.911**
	Sig. (2-tailed)	.000
	N	68

**. Correlation is significant at the 0.01 level (2-tailed).

The study sought to establish the relationship between dairy funding and team enhancement of livelihoods. A correlation analysis was conducted as shown in Table 12 to test the null hypothesis that dairy funding does not influence on-farm dairy diversification projects in enhancing the livelihoods of small scale farmers in Bureti sub-county. The study established that there was a strong positive and significant correlation between dairy funding and the enhancement of livelihoods for smallholder farmers ($r_=$ 0.911). Based on the decision rule for significant level, we reject the null hypothesis and conclude that dairy funding influences on-farm dairy diversification projects in enhancing the livelihoods of small scale farmers in Bureti sub-county. The findings imply that dairy funding greatly affect the enhancement of livelihoods of the smallholder farmers in Bureti and therefore should be given a cardinal priority.

Relationship between Milk Production Sustainability and Enhancement of Livelihoods

This section analyzes the relationships between milk production sustainability and the enhancement of livelihoods of smallholder farmers.

Table 13: Relationship between Milk Production Sustainability and Enhancement of Livelihoods

		Milk Production Sustainability
Enhancement of Livelihoods	Pearson Correlation	.876*
	Sig. (2-tailed)	.039
	N	68

*. Correlation is significant at the 0.01 level (2-tailed).

The study further sought to establish the relationship between milk production sustainability and enhancement of livelihoods for smallholder farmers in Table 13. The study conducted a correlation analysis to test the null hypothesis that milk production sustainability does not influence on-farm dairy diversification projects in enhancing the livelihoods of small scale farmers in Bureti sub-county. The coefficient of Correlation ($r_=$ 0.876) shows a strong positive and significant relationship between milk production sustainability and enhancement of livelihoods. Therefore based on the decision rule, we reject the null hypothesis and conclude that dairy funding influences on-farm dairy diversification projects in enhancing the livelihoods of small scale farmers in Bureti sub-county. This finding implies that increasing the sustainability of milk production equally enhances the livelihoods of the smallholder farmers.

Relationship between Technology Adoption and Enhancement of Livelihoods

This section analyzes the relationships between technology adoption and the enhancement of livelihoods of smallholder farmers.

Table 14: Relationship between Technology Adoption and Enhancement of Livelihoods

		Technology Adoption
Enhancement of Livelihoods	Pearson Correlation	.792*
	Sig. (2-tailed)	.030
	N	68

*. Correlation is significant at the 0.01 level (2-tailed).

In Table 14, the study sought to establish the relationship between technology and enhancement of livelihoods by conducting a correlation analysis. The findings show the existence of a strong positive and significant relationship between technology adoption and enhancement of livelihoods of smallholder farmers. Based on the decision rule for significant level, we reject the null hypothesis and conclude that technology adoption influences on-farm dairy diversification projects in enhancing the livelihoods of small scale farmers in Bureti sub-county. Therefore, technology adoption is one of the most important factors influencing the enhancement of livelihoods of smallholder farmers through on-farm dairy diversification projects.

Relationship between Production Risk Control and Enhancement of Livelihoods

This section analyzes the relationships between production risk control and the enhancement of livelihoods of smallholder farmers.

Table 15: Relationship between Production Risk Control and Enhancement of Livelihoods

		Production Risk Control
Enhancement of Livelihoods	Pearson Correlation	.679*
	Sig. (2-tailed)	.023
	N	68

*. Correlation is significant at the 0.01 level (2-tailed).

Further, the study sought to establish the relationship between production risk control and enhancement of livelihoods. From Table 15, the correlation analysis findings show that there exists a strong positive and significant relationship between production risk control and enhancement of livelihoods. Based on the decision rule for significant levels, we reject the null hypothesis and conclude that technology adoption influences on-farm dairy diversification projects in enhancing the livelihoods of small scale farmers in Bureti sub-county. The findings imply that production risk control should be focused upon by smallholder farmers and other stakeholders to realize the benefits of on-farm dairy diversification projects in enhancing the livelihoods.

Regression Analysis

The researcher conducted a multiple regression analysis to assess on-farm dairy diversification projects in enhancing livelihoods of small scale farmers in Bureti sub-county.

Table 16: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.901[a]	0.812	0.816	0.003

a. **Predictors**: **(**Constant), Dairy funding, milk production sustainability, technology adoption and production risk control

The Regression model summary in Table 16 shows that the four independent variables in the regression model (Dairy funding, milk production sustainability, technology adoption and production risk control) account for 81.6% of the total variation in on-farm dairy diversification projects because the 'R square' value is 0.812. This finding is consistent with Toole (2013) who posited that a model that yields an R square value above 0.25 is considered to be of good fit in social sciences. As a result, further research should be conducted to investigate the other factors constituting (18.8%) that affect on-farm dairy diversification projects in Bureti sub-county. ANOVA test was conducted to test the significance of the relationship between the independent and dependent variables by predicting the power of the model with that of an intercept only model (Faraway, 2002). The results in Table 17 show that the P-value of 0.000 was established from the ANOVA test. This reveals the existence of a statistically significant relationship between livelihood enhancement and the four independent variables (Dairy funding, Milk production sustainability, technology adoption and production risk control).

Table 17. ANOVA for Model 1

Model		Sum of Squares	Df	Mean Squares	F	Sig.
1	Regression	77.113	3	25.704	128.391	0.000[b]
	Residual	12.814	64	0.2002		
	Total	89.927	67			

a. Dependent variable: Enhancement of livelihoods for smallholder farmers Predictors: (Constant), Dairy funding, Milk production sustainability, technology adoption and production risk control).

Multiple Regressions Analysis

Multiple regression analysis was conducted to assess the relationship between on-farm dairy diversification projects and enhancement of livelihoods of small scale farmers in Bureti sub-county in Table 18.

Table 18: Regression Coefficients for Model 1

Model	Un-standardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	1.432	1.825		1.057	.0155
Dairy Funding	0.742	0.306	0.352	3.425	.0176
Milk production sustainability	0.738	0.665	0.288	3.283	.0181
Technology adoption	0.699	0.449	0.207	3.280	.0167
Production risk control	0.676	0.361	0.280	3.195	.0148

a. Dependent Variable: Enhancement of livelihoods for smallholder farmers

$Y = 1.432 + 0.742X_1 + 0.738X_2 + 0.699X_3 + 0.676X_4$ Where Y_i = Enhancement of livelihoods of smallholder dairy farmers, X_1 = Dairy funding, X_2 = Milk production sustainability, X_3 = Technology adoption and X_4 = Production risk control

The beta values that were obtained explained the regression equation. The standardized beta coefficients give a measure of influence of each variable to the model and indicate how much the dependent variable varies with an independent variable when all other independent variables are held constant. The regression model established that taking all factors into account (dairy funding, milk production sustainability, technology adoption and production risk control) at zero, the constant is 1.432. The findings imply that taking all other independent variables at zero, a unit increase in dairy funding leads to a 0.742 increase in enhancement of livelihoods; a unit increase in milk production sustainability leads to 0.738 increase in enhancement of livelihoods, a unit increase in technology adoption will lead to 0.699 increase in enhancement of livelihoods while a unit increase in production risk control leads to 0.676 increase in enhancement of livelihoods.

SUMMARY OF FINDINGS

Assessment of Dairy Funding

From the findings, insufficient dairy funding affects the contribution of on-farm dairy diversification projects in enhancing the livelihoods of smallholder farmers. The loan collateral needed by financial institutions inhibit access to funds by smallholder dairy farmers. The study further revealed that interest rates charged by commercial banks are high and unaffordable by dairy farmers in Bureti sub-county. High interest rates combined with collateral and security requirements for bank loans have limited financial access by smallholder dairy farmers.

Therefore, most farmers borrow finances from informal groups for their dairy projects. Limited access to dairy funding implies that the smallholder dairy farmers face challenges in expanding their dairy diversification projects. The study also established that the county government of Kericho provides financing for smallholder dairy farmers. From the findings, it can be inferred that dairy funding is very important in the dairy diversification projects for smallholder dairy farmers.

Assessment of Technology Adoption

The study established that lack of enough livestock extension services and training affects smallholder dairy farming activities. The farmers have access to AI (Artificial insemination) services and other breeding services. The study established that there were not enough milk cooling equipments and collection centres. Furthermore, the farmers are not adequately trained on new technologies for feeding dairy cows. Not all farmers have access to milk processing facilities at the local level to ensure milk is not spoiled. The findings on technology adoption imply that there are quite a number of gaps in technology awareness, acquisition and use by the smallholder farmers in Bureti sub-county. Only AI adoption has been used probably because it has been around for quite a while now. Therefore, the smallholder farmers need to be empowered through capacity building and sensitization on the benefits of technology adoption in feeding their dairy cows, milk production, and processing and value addition to earn more income. This way, they can create more employment opportunities and improve on their livelihoods.

Assessment of Production Risk Control

The study established that smallholder dairy farmers are not often trained on production risks. Production forms one of the biggest obstacles facing smallholder dairy projects because diseases and weather fluctuations are always experienced by every farmer. Majority of the smallholder farmers have insured their dairy animals against diseases, death or theft. Additionally, insurance companies are available but have not trained farmers on insurance policies for their dairy activities. Insurance products and premiums in the market are not affordable by smallholder dairy farmers probably due to lack of awareness and knowledge. However, the government provides animal vaccinations and treatments for the farmers. The aspect of insurance, insurance products and premiums for dairy farmers is not well understood by the smallholder farmers. This implies that insurance companies have not managed to penetrate the dairy farming adequately and therefore a lot of awareness, training and marketing

should be done. In addition, farmers have not been adequately trained on production risk control, its benefits and implementation in their dairy diversification enterprises.

Assessment of Milk Production Sustainability

The study assessed the influence of milk production sustainability on on-farm dairy diversification projects in enhancing the livelihoods of smallholder farmers. It was established that lack of basic skills on dairy farming affects milk Production sustainability. Lack of specific and relevant skills in dairy farming hamper milk production and low level of education of the smallholder farmers affect milk production among smallholder dairy farming projects. The study also established that limited knowledge on funding sources constrain milk production from smallholder dairy farming projects. Moreover, unpredictable weather conditions affect smallholder dairy farming projects in terms of milk output/production.

CONCLUSIONS OF THE STUDY

This section deals with the conclusions of the study findings on dairy funding, technology adoption, and milk production sustainability and production risk control.

Dairy Funding

The study concludes that insufficient dairy funding affects the contribution of on-farm dairy diversification projects in enhancing the livelihoods of smallholder farmers. Loan collateral requirements by financial institutions inhibit access to funds by smallholder dairy farmers. High interest rates charged by commercial banks makes their loans unaffordable by dairy farmers. High interest rates combined with collateral and security requirements for bank loans have limited financial access by smallholder dairy farmers. Majority of the farmers borrow finances from informal groups for their dairy projects. The county government of Kericho provides financing for smallholder dairy farmers. Dairy funding is very important in the dairy diversification projects and positively impacts the enhancement of livelihoods of the smallholder farmers.

Technology Adoption

The study concludes that lack of enough livestock extension services and training affects smallholder dairy farming activities. The farmers have access to AI (Artificial insemination) services and other breeding services. There are not enough milk cooling equipments and collection centres. Furthermore, the farmers are not adequately trained on new technologies for feeding dairy cows. Not all farmers have access to milk processing facilities at the local level to

ensure milk is not spoiled. There is need to create technology awareness, acquisition and use by the smallholder farmers in Bureti sub-county. Not all the farmers have benefitted from milk processing facilities and cooling equipment meaning some of them make losses as a result of spoiled milk. Technology has the potential to help the smallholder farmers realize great benefits from dairy diversification projects.

Production Risk Control

The study concludes that smallholder dairy farmers are not often trained on production risks which form the biggest obstacles facing smallholder dairy. Majority of the smallholder farmers have not insured their dairy animals against diseases, death or theft. Additionally, insurance companies are available but have not trained farmers on insurance policies, products and premiums. Insurance products in the market are not affordable by smallholder dairy farmers due to lack of awareness and knowledge. The government provides dairy animal vaccinations and treatments for the smallholder farmers. The aspect of insurance, insurance products and premiums for dairy farmers is not well understood by the smallholder farmers.

Milk Production Sustainability

The study concludes that lack of basic skills on dairy farming affects milk Production sustainability. Lack of specific and relevant skills in dairy farming hamper milk production and low level of education of the smallholder farmers affect milk production among smallholder dairy farming projects. The study also established that limited knowledge of funding sources constraint milk production from smallholder dairy farming projects. Unpredictable weather conditions affect smallholder dairy farming projects in terms of milk output/production.

RECOMMENDATIONS OF THE STUDY

Dairy Funding

The study recommends that smallholder dairy farmers should seek sufficient dairy funding for effective on-farm dairy diversification projects. Financial providers should review the loan collateral requirements and broaden access of funds to smallholder farmers by developing specialized products. The banks should consider revising the high interest rates charged as this makes loans unaffordable by dairy farmers. The smallholder dairy farmers should strengthen their informal groups to enable them provide relatively bigger loans to meet their dairy farming needs. The county government of Kericho should create a special revolving fund for dairy farmers and continue supporting their enterprises as a way of creating jobs and opportunities to its people.

Technology Adoption

The study recommends that livestock extension services and training of smallholder dairy farmers should be enhanced. The farmers, County government and other stakeholders in the dairy sector should come together and develop a strategy on how to buy enough milk cooling equipments, processing facilities and build more milk collection centres. Training on dairy technologies, their use and cost should be prioritized and conducted to ensure smallholder farmers benefit and implement them.

Production Risk Control

The study recommends training of the smallholder dairy farmers on production risks, management of the risks and the actual implementation of risk control measures. The farmers should be sensitized on insurance products and how they can ensure their dairy animals to ward off losses whenever risks occur. The insurance companies should train farmers on insurance policies, products and premiums so that they can easily buy the insurance covers for their dairy animals. The government should continue providing dairy animal vaccinations and treatments for the smallholder farmers' cows.

Milk Production Sustainability

The farmers should be trained on milk production sustainability technical skills and feeding technologies to ensure their dairy cows produce enough milk capable of generating sufficient incomes and enhance their livelihoods. The farmers should be trained on financial literacy and loan management to ensure they understand the loan terms and conditions, repayment and loan collateral requirements.

LIMITATIONS AND FURTHER RESEARCH

This study analyzed only four variables (dairy funding, milk production sustainability, technology adoption and production risk control) and their influence on enhancing livelihoods of smallholder dairy farmers in Bureti Sub-County. Further, the respondents were a bit reluctant to provide relevant information at the beginning for fear of being exposed or investigated or misused for the benefit of the researcher. The study further encountered limitations emanating from respondents' fear of giving information regarding their dairy farming activities which they greatly treasure in their cultures.

The study recommends that further research should be conducted on the implications of insurance risk management on on-farm dairy diversification projects in Kenya.

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