INTERNATIONAL JOURNAL OF SOCIAL Sciences and Information Technology
ISSN 2412-0294 www.ijssit.com

http://www.ijssit.com

INFLUENCE OF SOCIO-ECONOMIC FACTORS ON FODDER ESTABLISHMENT IN SMALLHOLDER DAIRY FARMING IN NYAMIRA COUNTY, KENYA

[1*] **Mokano Dorca Kwamboka**
dorcakwamboka@gmail.com

[2**] **Jane Kapkiyai**
janekiyai@yahoo.com

[3***] **Evans Basweti**
eabasweti@gmail.com

[1, 2, 3] *School of Agriculture and Natural Resources Management, Kisii University, Kenya*

Abstract: *Dairy farming in Nyamira County faces challenges related to low milk production, primarily due to inadequate fodder production among smallholder farmers. This study aimed to explore the influence of socio-economic factors on fodder establishment in smallholder dairy farming in Nyamira County, Kenya. Employing a descriptive survey research design, data were collected from 236 smallholder farmers and 60 field officers through questionnaires and interviews. The findings revealed that socio-economic factors significantly influence the adoption of fodder establishment technologies, with individual land ownership and population density being key determinants. Statistical analysis showed a positive relationship between socio-economic factors and fodder adoption, with a correlation of 57.3%. The study concluded that enhancing socio-economic conditions could improve fodder production, thereby boosting dairy farming productivity in the region. The findings contribute to the Government of Kenya's Big Four Agenda, particularly in achieving food security and improving household income. Recommendations include targeted interventions by Nyamira County management to address the socio-economic barriers identified.*

Keywords: *Socio-economic factors, fodder establishment, small-holder, dairy farming*

Introduction

Fodder production and establishment have been identified as an appropriate intervention towards improving household nutritional status and poverty alleviation. This is because fodder production and establishment provide cheap and accessible fodder hence this is possible through improved technology and sensitization of the small holder farmers to provide surplus feeds of dairy animals (African Development Solutions (ADESO), 2012). Both annual and perennials planted fodder crops are important animal feed resources in Kenya due to their superiority in dry matter yield which is an essential requirement in dairy production (Thairu and Tessema, 2013).

Small-holder Dairy Farming in Kenya

Kenya's dairy sector stands as one of East Africa's most vibrant industries, prominently featuring smallholder farmers who wield considerable influence within the country's dairy landscape. These smallholder dairy farmers constitute a significant portion of Kenya's dairy production, estimated at 70-80% of the total output (Ojango et al., 2015). Dairy production primarily concentrates in the Kenyan highlands, characterized by altitudes exceeding 1000 meters, thus fostering favorable agro-ecological conditions for dairy farming (Staal

et al., 1997). The densely populated nature of these areas ensures a readily available market for the milk produced. Nyamira County, nestled in western Kenya, serves as a microcosm of the prevalence of smallholder dairy farming across the nation. Despite its modest geographical size, Nyamira hosts a substantial number of smallholder dairy farmers, reflective of broader trends observed throughout Kenya (Ondiko et al., 2019). However, these farmers confront distinct challenges and constraints, including limited resource access, deficient extension services, and volatile milk prices, necessitating bespoke interventions to bolster their livelihoods (Muriuki et al., 2017).

The smallholder dairy sub-sector is integral to Kenya's dairy industry, contributing significantly to the nation's milk per capita availability and consumption (Ngigi, 2004). Remarkably, smallholder dairy farmers represent 80% of the total number of dairy farmers in the country, accounting for 70% of the total milk produced (IFAD, 2006). Moreover, the dairy production landscape in Kenya is distinguished between small-holder and large-holder farming, with smallholder farming prevailing as the most popular option (Karanja, 2004). It further delineates into four subgroups, namely resource-poor, small-holder intensive, part-time dairy farmers, and crop-oriented dairy farmers (IFAD, 2006), each exhibiting distinct characteristics and constraints.

Resource poor farmers in the smallholder dairy sector typically face significant challenges due to limited access to resources such as land, capital, and inputs. These farmers often operate on small land holdings and may lack adequate infrastructure for dairy farming. As a result, they struggle with low productivity and face difficulties in accessing markets, veterinary services, and extension support. Resource constraints hinder their ability to invest in modern technologies and best management practices, leading to suboptimal production levels. Additionally, limited financial resources may restrict their ability to purchase quality feed and veterinary medicines, further exacerbating their challenges. Despite these constraints, resource poor farmers often demonstrate resilience and innovation in adapting traditional practices to maximize production within their means. Understanding the specific challenges faced by resource poor farmers is crucial for designing targeted interventions aimed at improving their access to resources, enhancing productivity, and promoting inclusivity in the dairy value chain.

Small-holder intensive farmers represent a subgroup of smallholder dairy farmers who focus on maximizing productivity within limited land sizes through intensive management practices. These farmers typically invest in technologies such as stall-feeding systems, improved genetics, and veterinary services to optimize production efficiency. They often maintain smaller herds but achieve higher milk yields per animal through strategic feeding regimes and regular veterinary care. Small-holder intensive farmers prioritize herd management, feed quality, and genetic improvement to enhance milk production and profitability. They may also engage in value-added activities such as milk processing or direct marketing to increase their income streams. Despite facing challenges such as limited access to credit and high input costs, small-holder intensive farmers demonstrate a strong commitment to improving their dairy enterprises through innovation and adoption of best practices.

Crop-oriented dairy farmers integrate dairy farming with crop production activities, either by feeding crop residues to dairy animals or practicing mixed farming systems. These farmers view dairy farming as a complementary enterprise to crop production and often prioritize crop production over dairy farming. They may allocate a portion of their land for forage production or maintain dual-purpose crop varieties that serve both as food for humans and feed for livestock. Crop-oriented dairy farmers leverage synergies between crop and livestock enterprises to optimize resource utilization and enhance farm profitability. They may adopt conservation agriculture practices to improve soil fertility and forage quality, thereby supporting both crop and

dairy production. Additionally, crop-oriented dairy farmers may benefit from diversification strategies that mitigate production risks and enhance resilience to climatic variability. Understanding the interactions between crop production and dairy farming among crop-oriented dairy farmers is crucial for promoting integrated farming systems and maximizing the potential synergies between different agricultural activities.

Fodder Production among Small-Holder Dairy Farmers in Kenya

In Kenya, fodder production is commonly practiced under intensive and extensive grazing units. Intensive grazing systems are characterized by: small land sizes, feeding of animal in stalls and minimal movement. There are those who practice extensive production where animals graze and they are not stall fed. The third method is where the farmers have a hybrid system such that the animals are fed in the stalls and also are allowed to graze on their own. These systems are normally referred to as free, semi-zero and zero grazing representing increasing intensification (Bebe *et al.,* 2003a). Many small-holder farmers practice intensive dairy farming where they do stall feeding and a combination of stall feeding and grazing. This is because of their small land sizes usually less than 5 acres (Bebe *et al.*, 2003a). Most of the farmers prefer to adopt the large mature breeds (Bebe *et al*., 2003b) as they believe they are more productive compared to others. In general, smallholder open grazing realizes less output than the zero grazing itself (Karanja, 2003). This can be attributed to the use of concentrate and supplements in the zero grazing system and intensive feeding programs.

Fodder Establishment and Production among Smallholder Dairy Farmers in Kenya

Cultivated fodder species are of two types: grasses and legumes. According to Fall et al. (2005), their yields vary based on a range of factors (rainfall for rain fed system or quantity and frequency of applied water for irrigated system, soil preparation, sowing date, density, soil fertilization, harvesting, drying and conservation techniques). In general, grass seeds are difficult to collect and have low germination rates. The annuals include both non-cultivated and cultivated species (such as -sorghum, millet, peanuts and corn grown for forage). The perennials are easy to multiply vegetatively and are more resistant to trampling, grazing and bush fires. The most common local species is *Andropogon gayanus*. When planted, these grass species require fertilization and can yield up to 22 tonnes per hectare 1 of biomass (Fall et al., 2005). Forage maize, sorghum and millet have also been tried but never reach the large scale adoption in the Sahel as farmers in this area value the grain more than the forage (Sanon and Kanwe, 2002; Pasternak et al., 2012).

Legumes constitute the second group of cultivated fodder species. For this group, many exotic species, mostly Australian herbaceous species and their cultivars such as - *Stylosanthes hamata*, *Macroptilium atropurpureus, Mucuna aterrina, M. purpurreum, S. gracilis, Vigna unguiculata, Lablab purpereus and Dolichos lablab,* have been introduced in the Sahel and screened on-station based on their biochemical and nutritional composition, fertilizer requirements, persistence, management and use as forage legumes (Thomas and Sumberg et al., 1995). In general they are annuals, germinate well but are less resistant small ruminant feeds in the Sahel to grazing than grasses and need to be planted annually. Being legumes, most are Nitrogen-fixers and do not require mineral fertilisation except for phosphorus at a rate of 50-200 kg ha_{-1} since most of the Sahelian soils are deficient in this nutrient.

Existing literature shows that *Stylosanthes hamata, Digitaria umfolozi, Eulesine indica, Eleusine coracana, Cenchrus ciliaris, M. atropurpureus, M. aterrina, S. gracilis, V. unguiculata, L. purpereus, Brachiaria ruziziensis, Panicum maximum,* and *Dolichos lablab* were introduced and evaluated in Mali. Feeding calves with green *S. hamata* fodder led to a daily body weight gain of 178 grams (Kouriba et al. 2008; Kouriba and Nantoumé, 2008). In Burkina Faso, research on cultivated forages started in 1961 involving various

institutions. These consisted of introducing exotic plant species which were then compared to local fodders species. A total of 42 species, including annual and perennial grasses, annual and perennial legumes, were tested for their adaptation to drought and productivity as well as their management. They produced about 1.5-20 tonnes per hectare depending on the management practices and the ecological zone (Sanon and Kanwé, 2002). The fact that most of the reports about this work are in the grey literature, did not help much with information circulation and thus avoiding costly duplication of efforts; and consequently contributing to limited adoption of the tested species in the Sahel.

Grasses and legumes can be grown separately or mixed as in the case of *P. maximum*, a grass and *S. hamate*, a legume. Legumes can also be associated with cereals or rotated with cereals as cover crops one season prior to growing the cereal crop (cereal-*Dolichos lablab*, cereal- *Mucuna* spp). The most adopted species in the Sahel are the dual-purpose cowpea, *D. lablab* and *Brachiaria spp*. Finally, both grasses and legumes have been associated with legume trees, and mostly on-farm trials in Mali associating four woody species such as *Acacia senegal, Gliricidia sepium, Pterocarpus erinaceus* and *P. lucens*, with *S. hamata* revealed no negative impact of trees on the production of legumes.

Evaluating pruning frequency of the woody species showed that harvesting twice a year yielded the highest biomass, allowing the highest carrying capacity with 0.52 TLU (Yossi et al., 2002). Most of these experiences have been conducted at plot level and there is a scarcity of information as to which attempts has been made to integrate these practices into the livestock systems through clientoriented research. Detailed site and system-specific analyses that would enable identifying livestock producers who can benefit from such a wealth of experiment findings are lacking. Therefore, most of the on-farm trials may have been conducted in situations where farmers do not face the problem that the promoted technologies are trying to address. As a consequence, there has been low adoption of these technologies despite of their perceived high value to most of the farmers (Hamer et al., 2007). The main constraints leading to low adoption include - the seeds delivery systems, funds, labour, land and tree tenure (Hamer et al., 2007). Therefore, there is need for more thorough investigations in that area, including both on the technologies (simplicity of the technique, acceptability of the species, profitability) as well as the target populations.

Statement of the Problem

Dairy farming remains a major concern among rural households especially in Nyamira County. Annual reports from Ministry of Livestock indicate that small-holder dairy farmers in Nyamira County have a low production of milk per cow per day due to inadequate improved fodder production (Ministry of Livestock, 2018). This means that the farmers are operating below optimum production capacity. The region has the most competitive processing sector with an excess capacity and the smallholder dairy farmers are well-placed to produce for this capacity if the conditions are right and met, however due to inadequate fodder production, there is low dairy milk production. Therefore, fodder production and conservation have been identified as an appropriate intervention towards improving dairy production, income generation, household nutritional status and alleviating poverty in Nyamira County.

Objectives of the study

The study employed the following objectives: to determine the extent to which socio-economic factors influence fodder establishment in smallholder dairy farming in Nyamira County.

The following research hypothesis was used, as derived from the research question and stated in its null form. H_{01}: There is no significant influence of socio-economic factors on fodder establishment in smallholder dairy farming in Nyamira County.

Significance of the Study

The present study is expected to yield the data paramount for fodder establishment in small-holder dairy farming. The Government of Kenya's Big Four Agenda in 2018 comprise of: manufacturing, universal healthcare, affordable housing and food security. Therefore, the findings of this study may contribute towards attaining the Kenya's Big Four Agenda. This implies that smallholder dairy farming stand a better platform as compared with other sectors of agriculture in this nation as far as marketing of the product is concerned.

Methodology of the Study

This study employed descriptive survey research design. The study targeted small holder farmers in Nyamira County and key government informants from the county. A total of 200 field officers and 2364 smallholder farmers in Nyamira county were available and these was targeted(Kenya Dairy Farmers Board, 2017). The target population therefore comprised of 2,564 respondents. The sample consisted of 10% of the target population for the smallholder dairy farmers while that of the field officers comprised of 30% of the target population (Mugenda and Mugenda, 2003). The following formula was used to calculate the sample sizes.

$$n=Nx\frac{10}{100}$$

Where n is the sample size, N is the population size, and 10% is the estimate

$$n=2364x\frac{10}{100}$$

$$n=236$$

The sample size therefore comprised of 236 smallholder farmers and 60 field officers. The sample was distributed proportionately. Stratified random sampling and simple random sampling were used to select the smallholder dairy farmers while purposive sampling was used to select the field officers. The strata A, B, C and D represented some of the sub-counties of Nyamira County with smallholder farmers where A represented Manga Sub-County, B- Nyamira South Sub-County, C- Borabu Sub- County and D- Masaba North Sub-County.

Table 1: Sampling Frame

Regions	A	B	C	D	Total
Population in each strata	625	577	578	584	2,364
Sampled	63	58	58	57	236

A = Manga Sub-County, B = Nyamira South Sub-County, C = Borabu Sub- County and D = Masaba North Sub-County

Data was collected using questionnaires. Structured and semi structured questionnaires were administered to a sample of 236 smallholder dairy farmers. The questionnaire collected information that addressed the objectives of the study; smallholder farmer demographics, farm size, source of fodder and resources, smallholder farmers coping strategies and fodder use practices. Before conducting the actual survey, the questionnaire were pre-tested among smallholder farmers to check whether it constituted the required information or if there was need to make some changes. Field officers were also interviewed. In addition, field observation and participation during the study were used as a supportive or supplementary technique to collect qualitative data that complemented data obtained by other means. Observation guide were used to assess major economic activities and fodder diversification, location of smallholder farms, farming patterns, resource degradation and accessibility to resources in the area. The correlation obtained in the study was 0.875 implying that the questionnaires were reliable to collect information. Test-retest technique was used in assessing reliability in the study by administering the same questionnaires twice to the same group of small-holder farmers. After some time the same questionnaires were administered to the same small-holder farmers. The correlation coefficient obtained was 0.883 which indicated a high level of reliability. Training was conducted for the team that was involved in the data collection exercise especially experts from the departments of extension services and development who were conversant with data collection techniques. The questionnaires were also pretested several times to improve them and also standardize administration procedures. Quantitative data were analysed using multiple regression analysis was adopted to analyse the factors influencing the adoption of fodder establishment technologies in smallholder dairy farming in Nyamira County. The regression equation was in the form:

$$Y= \beta_0+ \beta_1X_1+ \alpha \quad (1)$$

Where Y, is the dependent variable (adoption of fodder establishment technologies in smallholder dairy farming), β_0 is the regression coefficient, β_1 is the constants and X_1 is socio-economic factors and α is an error term normally distributed about a mean of 0 (for purposes of computation, the α was assumed to be (0).

Findings of the Study

The objective of this study was to determine the extent to which socio-economic factors influence fodder establishment in smallholder dairy farming in Nyamira County. To achieve this objective, the researcher investigated a number of variables and presented as the following tables and figures.

Table 2 shows the socio-economic factors and fodder establishment in smallholder dairy farming.

Table 2: Ownership of small holder dairy farm

Ownership of small holder dairy farm	Frequency	Percent
INDIVIDUAL	131	60.9
FAMILY	82	38.1
GROUP	02	1.0
Total	215	100

Individual smallholder dairy farm ownership influenced adoption greatly, 60.9%. This was considered the case since those with individual land ownership have security of tenure and as such can make individual decisions

without any fear of losing ownership. Family type of ownership influenced adoption at 38.1%. In this case, the smallholder dairy farmers do have security of tenure and therefore any decisions to be made on a technology to be adopted are not vested with the farmer but will be made by another person. This to some extent affects the adoption of a technology since not all technologies will be taken by the person to make that decision. Only few (0.5%) smallholder dairy farms were owned by a group and other systems of ownership which influenced adoption of technology. There is a long processes involved in decision making on adoption of technologies which affects adoption in the long run.

Table 3: The population distribution of the smallholder farmers in Nyamira County

Population Distribution	Frequency	Percent
Sparsely distributed	08	3.7
Densely distributed	119	55.4
Evenly distributed	88	40.9
Total	**215**	**100.0**

The population distribution is key in adoption of a fodder establishment technology. Sparsely populated population influenced adoption at 3.7%. This can be explained by the fact that since there is no competition between man and livestock on the source of livestock feed. Areas with a densely populated population density had an influenced on adoption of fodder establishment technologies at 55.3%. Due increasing human population, there's minimum land left for free grazing and livestock are mostly confined within stalls and the feeds are cut and carried to the livestock. This set up dictates that fodder has to be established somewhere, be tendered before its cut and taken to the livestock in stalls for feeding. These smallholder farmers will adopt fodder establishment technologies faster than those in sparsely populated areas.

Evenly distributed population influenced adoption of a fodder establishment technology at 40.9%. In such set up, the use of both intensive and semi intensive methods of feeding livestock are common. In these systems, livestock are allowed to graze in an open land and later on moved to stalls for feeding and sleeping. This system pushes smallholder farmers to adopt technologies which will increase production of fodder to provide readily available food for the livestock.

Table 4: Availability of extension services to smallholder dairy in Nyamira County

Availability of Extension Services	Frequency	Percent
Readily available	49	22.8
Available only when needed	144	67.0
Not available	22	10.2
Total	**215**	**100.0**

Availability of extension services to smallholder farming households influenced the adoption of fodder establishment technology in varying levels. Availability of extension at all levels influenced adoption at 22.8%. This was the case since the smallholder farmers found it as a normal routine to have extension services within their reach. The familiarity between extension officers and farmers doesn't make farmers see anything new in their advices. This affected the adoption. Majority of the farmers were influenced (66.5%) to adopt the technology when the availability of extension services was when needed. This was found to be the case since

in smallholder farms where extension services are availed only when needed, the smallholder farmer takes the extension officer and the services offered very seriously thereby influencing adoption of fodder establishment technologies. In such set up, there is no familiarity between the extension officers and farmers but only come together for serious engagements only. Non availability of extension services influenced adoption of fodder establishment technologies at 10.7%. This was found to be the cases since many smallholder farmers tend to have no knowledge of the available technology that should be adopted. Non availability of extension services becomes a big hindrance to adoption of any technology among the smallholder farmers' households. Plate 4.4 shows some of the extension officers with the small-holder dairy farmers.

Plate 1 Extension Officers with small-holder dairy farmers

The study sought the dairy farming systems used by the small-holder dairy farmers in Nyamira County and their responses are as in Table 5 next page.

Table 5: Dairy farming systems

Dairy Farming Systems	Frequency	Percent
Intensive	53	24.7
Semi-intensive	162	75.3
Total	**215**	**100.0**

The dairy farming system was the main factor that influenced adoption of fodder establishment technology. Smallholder dairy farmers who had their animals under full intensive system were influenced to adopt new fodder establishment technologies at 24.7%. This is because under intensive system, the animals are fully housed in stalls and feeds are availed to the livestock in those stalls. This dictates that fodder is established in a farm, cared for and once it's mature, the feed is cut and carried to the livestock for feeding. These households were always ready to adopt a fodder establishment technology that will increase production per unit area to provide enough feed for the livestock.

Semi intensive system of livestock rearing influenced adoption of fodder establishment technology at 75.3%. Concerning the semi intensive system of rearing, the system entails an arrangement where animals are allowed to graze in the open for sometimes before they are moved into stalls structures constructed to house the animals. This system demands that fodder is established and taken care of in the fields, then its carried and fed to animals either in the stalls or in the open grazing land. This system greatly influenced the adoption of fodder establishment technology as many households wanted a system that will increase fodder production and productivity. Many households under semi intensive system adopted faster than those under intensive system of grazing.

Table 6: The number of dairy animals kept

Number of dairy animals kept	Frequency	Percent
Two	59	27.4
Three	54	25.1
Four	51	23.7
Five	31	14.4
More than 5	20	9.3
Total	**215**	**100.0**

Farmers with two animals influenced at 27.4%. This was found to be the case since many were under intensive or semi intensive system and the farmers had very close monitoring of the animals. The two animals could be animals of hybrid vigor and hence high producers that need more feeds. This farmer will need to establish high yielding fodder to satisfy their feed requirements those with three animals were influenced at 25.1%. This was found to be the case as many of these animals were under semi intensive or intensive system as others were also allowed free time to graze in the fields. Many of such animals are usually cross breeds with moderate production and feed requirements. Households with four animals were influenced at 23.7 (51 respondents) since many of the animals were allowed to open graze in the open fields and farmers needed least or no new feeds to feed the animals and were comfortable with the field grazing. Those with five and more than five animals were influenced at 14.4% and 9.3% (20 respondents) respectively since many of the farmers under this households do not house their animals in any stalls but rather allow them to graze in the open fields where

they feed on the natural pastures and hence do not need any new fodders and thus rarely adopt any new fodder establishment technologies.

Table 7: Religion

Religion	Frequency	Percent
CATHOLIC	69	32.1
PROTESTANTS	90	41.9
OTHER	56	26.0
Total	215	100

The religious beliefs of the farmers influenced the adoption of fodder establishment technologies. Results showed that 32.1% of the Roman Catholic believers adapted to new technologies of fodder establishment. This was because the church sets aside some time to talk about farming during their services. 41.9% of the Protestants had influence in the adoption of fodder establishment technologies. The protestant churches have special sessions set aside to discuss family life matters and encourage its believers on how to increase and create income for their households. During these sessions, extension officers are invited to the churches to educate their believers on various ways of increasing production and productivity per unit area. The other forms of religious faiths like Muslims, Hindus, Budhists, atheists among others had an influence of 26.0% (56 respondents). This is because such religious believers do not set aside anytime during their services to talk about agricultural interventions but commit their times into religious teachings. Provision of agricultural information in places of worship during services is the main reason why the influence was higher in protestant churches as compared to the Roman Catholics and other religions.

Table 8: Status of family income for the smallholder dairy farmers in Nyamira County

Status of Family Income (Kshs.)	Frequency	Percent
Low income earners (Kshs. 1,000 – 5,000)	66	30.7
Medium income earners (Kshs. 5,000- 15,000)	119	55.3
High income earners (> Kshs. 15,000)	30	14.0
Total	**215**	**100.0**

The level of income for individual smallholder households had a bearing on the influence of adopting fodder establishment technologies. Low income earners influenced adoption of fodder establishment technologies by 30.7%. This was expected, with low income, they do not have enough money to invest in fodder establishment as the available income is directed to cater for household food and education for the dependents. Medium income households were influenced to adopt fodder establishment technologies at 55.3% this was because, after allocating money for household food and school fees, these households have some income reserves to invest in fodder establishment to create more income for the household and or create more food in form of livestock products for the household.

High income influenced adoption of fodder establishment technologies at 14.0%. This was found to be the case since those with high income do not have time to invest in fodder or agricultural interventions. They dedicate their income in investing in real estates and transport industries which are assumed to be having higher returns per unit investment than fodder or agriculture.

Correlation Statistics for Linear Relationship between Variables

Pearson's correlation measures the strength and direction of the linear relationship between variables. In this study, it measured the strength and direction of socio-economic factors in relationship with the adoption of fodder establishment. The correlations results were presented in Table 9.

Table 9: The correlation statistics for linear relationship between variables

	Adoption of fodder establishment	Socio-economic factors
Adoption of fodder establishment	1	
Socio- Economic factors	.573**	1

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

The Pearson's correlations in Table 9 showed that socio-economic factors was also positively related to adoption of fodder establishment ($r= 0.573$, $\alpha< 0.01$). This showed that socio-economic factors had 57.3% significant positive relationship with adoption of fodder establishment.

The study findings provided enough evidence to suggest that there was linear and positive relationship between socio-economic factors and adoption of fodder establishment by the small-holder dairy farming. This paved way for multiple regression analysis.

Hypothesis Testing

A multiple regression model was performed to test the hypotheses that were tested to determine the relationship between factors influencing adoption of fodder establishment by small-holder dairy farming. The findings were presented in Table 10.

Table 10: Multiple Regression Model

	Unstandardized Coefficients	Standardized coefficients		
	B	Std. Error	T	Sig.
Constant	0.0496	3.4404	0.0086	0.0002
Socio-economic factors	0.1153	0.0588	1.4509	0.0001
Multiple R	0.7963			
R Square	0.6341			
Adjusted R Square	0.6339			

Standard Error	1.0322
Observation	215
F	5.8832
Sig.	0.00000

F value Sig- Significance
Dependent Variable: Adoption of fodder establishment $\alpha = 0.05$

Hypothesis 1 (H_{o1}) postulated that there is no s significant influence of socio-economic factors on adoption of fodder establishment in smallholder dairy farming in Nyamira County. Findings showed that socio-economic factors had coefficients of estimate which was significant; $\beta_2 = 0.1153$ (p-value = 0.0001).This implies that the null hypothesis should be rejected and it was concluded that there is significant influence of socio-economic factors on adoption of fodder establishment in factors smallholder dairy farming in Nyamira County. This indicates that increase in socio-economic factors leads to an increase in fodder.

The relationship between factors and adoption of fodder establishment by small-holder dairy farming led to testing of the following regression equation:

$$Y = \beta 0 + \beta 1 X1 + \alpha$$

Y = The dependent variable (Adoption of fodder establishment by small-holder dairy farmers) β_0 = Regression coefficient β_1 = slope of the regression equation

X_1= Socio-economic factors

α is an error term normally distributed about a mean of 0 (for purposes of computation, the α is will be assumed to be 0).

The regression model equation obtained in the study is therefore:

$$Y=0.0496+ 0.1153X_1+ \alpha \quad (2)$$

Conclusion

It was established that smallholder farm ownership influenced the adoption of a fodder establishment technology. Individual smallholder farm ownership influenced adoption at 60.9%. The smallholder farm that had family type of ownership influenced adoption at 38.1%. This was perceived the case since with family ownership, the smallholder farmer doesn't have security of tenure and any decisions on a technology to be adopted doesn't vest with the farmer but will be made by another person. This to some extent affects the adoption of a technology since not all technologies will be taken by the person to make that decision. Smallholder farm owned by a group and other systems of ownership each influenced adoption of technology at 0.5% since the two form of ownership do not have security of tenure and decision making doesn't rest with an individual person but a group or team of people. There is a long processes involved in decision making on adoption of technologies which affects adoption in the long run.

It was found out that socio-economic factors was positively related to adoption of fodder establishment ($r= 0.573$, $\alpha< 0.01$). This showed that socio-economic factors had 57.3% significant positive relationship with

adoption of fodder establishment. Socio-economic factors had coefficients of estimate which was significant basing on β2=0.1153 (p-value= 0.0001 which is more than α=0.05) hence the null hypothesis was rejected and stated that there was significant influence of socio-economic factors on adoption of fodder establishment in factors small-holder dairy farming in Nyamira County. This indicated that increase in socio-economic factors leads to an increase in fodder. The socio-economic factors is stated by the t-test value=1.45092 which indicates that the influence of socio-economic factors surpasses that of error.

Based on the findings of this study, it was concluded that there was enough evidence to suggest that there was linear and positive relationship between socio-economic factors and adoption of fodder establishment by the small-holder dairy farming. An increase in one unit, the adoption of fodder establishment increases by 0.1153. Based on the findings of this study, the following recommendations are made: The management of the Nyamira County should address the socio-economic factors influencing fodder establishment in smallholder dairy farming. This can be done by use of the findings of this study.

References

Baltenweck, I. & Staal S.J. (2000). Determinants of adoption of dairy cattle technology in the Kenyan Highlands; A Spatial and Dynamic Approach.

Bebe B.O., H.M.J. Udob, G.J. Rowlands, W. Thorpe (2003) Smallholder dairy systems in the Kenya highlands: breed preferences and breeding practices, Livestock Production Science p. 82:117– 127.

Gay, L.R. (1992). Educational research: competencies for analysis and application. (4th Ed.). Columbus: Merrill Publishing Co.

IFAD. (2006). Small holder Dairy Commercialization in Kenya Program Report. Nairobi. Government Printers.

Karanja, M. (2003). The Dairy Industry in Kenya: The Post-Liberalization Agenda. Paper presented at a Dairy Industry Stakeholders Workshop held in Nairobi, Kenya on 27th August 2002.

Land O' Lakes (2008). Milk Shed Assessment and Small Business Organizations Needs Analysis.

Muriuki, H., Omare A. Hooton, N. Waithaka M., Ouma R., Staal S.J. & Odhiambo, P. (2004). The policy environment in the Kenya dairy sub-sector; A review.

Muriuki, H.G. (2001). Kenya country paper. A paper presented at the South-South Workshop on mall holder dairy production and marketing – constraints and opportunities, 13th – 16th March 2001, Anand, Gujarat.

Muriuki, H. G., et al. (2017). Challenges facing smallholder dairy farmers in Kenya: A case of Bahati Division in Nakuru District, Kenya. International Journal of Science and Research (IJSR), 6(1), 2319-7064.

Ngigi, M. (2004). Building on successes in African agriculture smallholder dairy in Kenya, Focus 12, Brief 6, of 10 April 2004, International Food Policy Research Institute.

Ojango, J. M., et al., (2015). Productivity and efficiency of smallholder dairy systems in the Kenya highlands. ILRI Research Report 33. International Livestock Research Institute.

Ondiko, J. O., et al. (2019). The prevalence of mastitis and associated risk factors in smallholder dairy farming systems in Nyamira County, Kenya. African Journal of Dairy Farming and Milk Production, 4(2), 49-56.

Hamer, A.G., Granzel, S., Mounkoro, B. (2007). Using farmers' criteria to assess profitability of fodder shrubs in the desert margins of West Africa. Land Degradation and Development 18: 670-679.

Sanon, H.O., Kaboré-Zoungrana, C., & Ledin, I. (2007). Edible biomass production from some important browse species in the Sahelian zone of West Africa. Journal of Arid Environments 71: 376-392.

Kombo, D. & Tromp, D.L.A (2006).Proposal and Thesis Writing, an Introduction, Panlives Publications Africa, Nairobi.

Mugenda O. & Mugenda, A. (2003).Research Methods: Quantitative and Qualitative Approaches, African centre of technology studies, Nairobi.