The Influence of Market Access Factors on Commercialization of Smallholder Dairy Value Chain Development in Uasin Gishu County, Kenya

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Abstract: Varied smallholder farming is central to livelihoods of many rural households in developing economies. Dairy farming in Kenya is the largest sub sector of agriculture growing at the rate of 4.1% per annum in comparison to 1.2% for agriculture sector as a whole. Commercializing smallholder dairy value chain development, therefore, is crucial in providing alternatives out of poverty and sustainable rural development. However, smallholder dairy value chain development is influenced by different factors at different levels of commercialization. Uasin Gishu County leads in milk production in Kenya with subsistence, semi-commercialized and commercialized farming being 70%, 20% and 10% respectively. Therefore, an assessment of market access factors on household commercialization may help unlock the transition from subsistence to commercialized smallholder dairy farming. The objective of this paper is to assess the influence of market access factors on commercialization of smallholder dairy value chain development. Guided by the theory of profit maximization, the paper utilized social survey research design and both secondary and primary data to execute the methodological process. A sample size of 384 smallholder dairy producers was studied out of a population of 50,457 respondents. Primary data was collected using structured questionnaires, focused group discussions, and key informants. The County was stratified into six sub-Counties and simple random sampling technique was used to select the respondents in each of the strata. Data was analyzed using descriptive statistics (mean and standard deviation) andinferential statistics (Pearson product-moment correlation coefficient; Spearman's rank correlation coefficient and multiple regressions) to describe and evaluate the relationship between market access factors (independent variables) and Household Commercialization Index (HCI) (dependent variable). The results the study concludes that the market access factors have significant influence on commercialization of smallholder dairy value chain development. In view of these results, it is recommended that the National and County Governments formulate policies, strategies, projects and programs that address the market access factors for increased level of dairy commercialization and sustainable rural development.

Keywords: Market Access Factors, Commercialization, Smallholder Dairy Producers, Smallholder Dairy Value Chain Development, Uasin Gishu County

1. Introduction

Majority of the population in Africa lives in the rural areas. Over 75% are smallholder farmers primarily depending on agriculture for their livelihoods [27]. In Kenya, smallholder dairy farming is the single largest component of agriculture growing at 4.1% per annum compared to 1.2% for agriculture as a whole and producing about 80% of total milk and 70% of the total milk marketed in the Country [4; 6]. Moreover, dairy industry accounts for 3.5% of the total Gross Domestic Product (GDP) and 14% of agricultural GDP [4, 6]. This huge economic value of the dairy sub-sector should be

tapped to contribute to the national development goals through transformation into globally competitive dairy value chain that provides alternatives out poverty [4, 6]. The Kenya National Dairy Master Plan [4], consistent with the Agricultural Sector development Strategy (ASDS) 2010-2020 and the Kenya Vision 2030 aims to transform the prevalent subsistence smallholder dairy farming to competitive, commercial and sustainable dairy activity that will lead to economic growth, poverty alleviation, employment and wealth creation. Commercializing smallholder dairy farming is therefore an indispensable alternative towards sustainable rural development for most developing countries relying on the dairy sector as an important route out of rural poverty [2]. Commercialization of smallholder dairy value chain development usually takes a long transformation process from subsistence to semi-commercial and then to fully commercialized dairy farming [20, 13, 4, 1]. The dairy value chain development in Kenya and in Uasin Gishu County in particular is characterized by smallholder dairy farming in which smallholder dairy producers are mainly subsistence-oriented with commercial smallholder dairy orientation being uncommon as categorized in the commercialization process as: 70% subsistence, 20% semi-commercialized and 10% commercialized [4, 5, 6]. This indicates that the commercialization of smallholder dairy value chain development is variable and has not yet reached critical mass to enable producers benefit from increased income and stimulate rural development [2, 4]. It is therefore important to assess the factors influencing this pattern of commercialization of smallholder dairy development in Uasin Gishu County. The objective of this paper therefore was to assess the influence of market access factors on commercialization of smallholder dairy value chain development in Uasin Gishu County, Kenya.

2. Methodology

This section describes the study area, discusses research design and data analysis methods.

2.1. Area of Study

Uasin Gishu County is located in the Rift Valley region of Kenya. It has a total area of 3,327.8 km^2. It strides between longitude 34°50′ and 35°37′ east and 0°03′ and 0°55′ north. It has a population of 448,994. The County is divided into six Sub-Counties namely: Soy; Turbo; Kapsaret; Kesses; Ainabkoi and Moiben [5]. Uasin Gishu is an agriculturally viable area. Smallholder dairy farming systems vary greatly in terms of number and type of dairy cows (1-10 grade cows and/or cross breeds; free grazing, semi-zero grazing and zero grazing; artificial insemination or bull service; and 2-10 acres land holding). The County was chosen as the study area because it is the leading milk producing county in Kenya. Dairy enterprise in the County is the most important livestock investment with annual net sales of approximately Ksh. 1.9 billionand has been identified as having the highest potential to contribute greatly to employment-led economic recovery [7]. It has the three (3) categories of smallholder dairy producers namely: subsistence (70%), semi-commercialized (20%) and commercialized (10%) smallholder dairy producers [5].

2.2. Research Design and Method of Data Analysis

This paper used cross-sectional research design. The methods of data analysis includes: Descriptive statistics (mean and standard deviation) and inferential statistics (Pearson product-moment correlation coefficient; Spearman's rank correlation (rho) coefficient and multiple regressions). The model below was used to examine theindependence-dependence structure between random variables as follows:

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \ldots + \beta_nX_n + \varepsilon. \tag{1}$$

Where: Y = Average HCI (Dependent variable)
Xi-n = market access factors (Independent variables)
β0= Constant or Point of intercept on Y axis
β1-n = Regression coefficients = Residual term or the error
The level of commercialization of smallholder dairy value chain development was measured using average Household Commercialization Index (HCI) given by the formula below:

$$HCI = \left[\frac{\text{Gross value of milk sales per household per month}}{\text{Gross value of total milk production per household per month}}\right] \times 100 \tag{2}$$

The household commercialization index (HCI) measures the extent to which household production is oriented towards commercialization. It ranges from zero to 100%. A value of zero signifies a totally subsistence oriented producer. The closer the index is to 100%, the higher the level of commercialization [19, 17]. This paper used dairy milk production and dairy milk sales in measuring average HCI of the households of the respondents. [13, 27, 17] provides scale of commercialization (HCI) as: 0% - 30%: subsistence oriented farmer; 31% - 65%: Semi-commercialized farmers; 66% - 100%: Commercialized farmers.

3. Results and Discussions

3.1. Commercialization of Smallholder Dairy Value Chain Development

The market access factors, their influence on the commercialization of smallholder dairy value chain development were analyzed using descriptive, correlation, regression and HCI. The results are shown in table-1; table-2; table-3 and table-4 respectively.

3.2. Descriptive Results

The descriptive results of market access factors shown in table- 1 are discussed as below:

As per the access to type of road, the proportions of respondents were as follows: 3.9% of respondents had access to tarmac roads whereas 64.8% accessed earth roads and 31.3%tomurramroads. Among the respondents, 35.2% of them were accessible to passable roads in all seasons meaning that most of the respondents (64.8%) therefore have challenges in transporting their produce to the markets and obtaining farm inputs from markets easily during the rainy seasons. This result implies that most of the respondents used earth roads when accessing markets for their products and inputs. In the case of access to good road network, the results indicate that 36.7% of respondents had access to good road network whereas 63.3% had no access to good road network. This results show that most of the respondents had no access to good road network in their areas hence affecting access to markets for their products and inputs.

The proportions of respondents as per their distance to markets indicate that: 23.2% of respondents were 4km away from the market; 20.1% were between 5km and 9km away; 11.7% were between 10km and 14km away; 15.9% were between 15km and 20 km away while 29.1% were over 20kmaway from the market and 43.3% of the respondents were less than 10 km away from the markets whereas 56.7% were more than 10km away from the markets. This result indicates that most of the respondents were far away from the markets hence negatively affecting access to markets for their products and inputs. The proportions of respondents as per their accessibility to electricity indicate that 36.2% of respondents were accessible to electricity whereas 63.8% were not accessible to electricity. This result shows that most of the respondents were not accessible to electricity hence affecting access to markets because they were not able to preserve their milk and even do value addition for increased incomes.

With respect to access to market information, 34.9% of respondents were accessible to market information whereas 65.1% were not meaning that most of the respondents were not able to access market information hence not able to access market for their produce. This then resulted into lesser sales of their produce and less income. Based on access to credit, 41.4% of respondents were accessible to credit whereas 58.6% were not. This means that most of the respondents are inaccessible to credit hence not able to access market for their produce. This is mainly due to lack of capital for investment in production, value addition and marketing in general. Among the respondents, 89.9% of them were accessible to inputs whereas 10.1% were not. This result shows that most of the respondents were accessible to various inputs hence able to increase their productivity.

The findings also show that 46.6% of respondents had their milk quality tested whereas 53.4% did not do so meaning that most of the respondents did not have their milk quality tested hence were not able to access wide range of markets for their produce. This makes the respondents to lose a lot of milk due to poor quality. In terms of cost of transport, results indicate that 31.3% of the respondents paid up to Ksh3000.00 for transportation of inputs and outputs whereas 28.4% paid up to Ksh100.00 for the same. This may vary from one respondent to another depending on the distance from the market and other factors. Also, 61.2% of the respondents paid Ksh 300.00 per month and above as cost of transport for their produce and inputs making the respondents not to get more income and access most of the markets due to high transport costs of their products and inputs.

With respect to the level of value addition of milk, 32.6% of respondents had their milk value added whereas 67.4% did not add value implying that most of the respondents did not have their milk value added hence were not able to fully access most markets for their produce. This makes the respondents not to get higher income from sales of their products. The proportions of respondents as per their membership in the farmers' organizations/institutions show that 67.2% of respondents were members of farmers' organizations/institutions whereas 32.8% were not members. This result indicates that most of the respondents were able to access markets because together they sold their produce at good prices and got inputs at lower prices. This resulted in higher produce value and lower input value. The analysis further reveals that 61.2% of the respondents were able to speak/understand English whereas 38.8% were not. This imply that majority of the respondents had received basic education and training on various aspects. This made the respondents to be able to access most of the markets due to their level of education which made them access market information. Finally, among the respondents, 50.5% of them owned transport whereas 49.5% did not. This implies that about half of the respondents owned transport. Transport ownership enables the respondents to access the markets due to available transport for the produce and inputs and this also reduces transport costs of outputs and inputs to and from markets.

Table 1. Descriptive Results for Market Access Factors.

Access to good type of road:			
Access to good type of road:	Frequency	Valid Percent	Cumulative Percent
Tarmac	15	3.9	3.9
earth road	249	64.8	68.7
Murram	120	31.3	100
Total	384	100	
Access to good road network:			
Access to good road network:	Frequency	Valid Percent	Cumulative Percent

Access to good type of road:			
Yes	141	36.7	24.7
No	243	63.3	100
Total	384	100	
Distance to market (Km):			
Distance to market (Km):	Frequency	Valid Percent	Cumulative Percent
1.00 – 4.00	89	23.2	23.2
5.00 – 9.00	77	20.1	43.3
10.00 – 14.00	45	11.7	55
15.00 – 20.00	61	15.9	70.9
Above 20km	112	29.1	100
Total	384	100	
Availability of electricity			
Availability of electricity:	Frequency	Valid Percent	Cumulative Percent
Yes	139	36.2	74
No	245	63.8	100
Total	384	100	
Access to market information:			
Access to market information:	Frequency	Valid Percent	Cumulative Percent
Yes	134	34.9	34.9
No	250	65.1	100
Total	384	100	
Access to credit			
Access to credit:	Frequency	Valid Percent	Cumulative Percent
Yes	159	41.4	41.4
No	225	58.6	100
Total	384	100	
Access to input:			
Access to input:	Frequency	Valid Percent	Cumulative Percent
Yes	134	89.9	89.9
No	255	10.1	100
Total	384	100	
Milk Quality Tested			
Milk Quality Tested:	Frequency	Valid Percent	Cumulative Percent
Yes	179	46.6	46.6
No	205	53.4	100
Total	384	100	
Cost of transport in Ksh/month:			
Cost of transport in Ksh/month:	Frequency	Valid Percent	Cumulative Percent
0	10	2.6	2.6
20.00 -100.00	109	28.4	31
150.00 -300.00	30	7.8	38.8
300.00 – 600.00	60	15.6	54.4
700.00-1000.00	55	14.3	68.7
1100.00 – 3000.00	115	31.3	100
Total	384	100	
Value addition			
Value addition:	Frequency	Valid Percent	Cumulative Percent
Yes	125	32.6	32.6
No	259	67.4	100
Total	384	100	
Member of farmer organization			
Member of farmer organization:	Frequency	Valid Percent	Cumulative Percent
Yes	258	67.2	67.2
No	126	32.8	100
Total	384	100	
Ability to speak/understand English			
Ability to speak/understand English:	Frequency	Valid Percent	Cumulative Percent
Yes	235	61.2	61.2
No	149	38.8	100
Total	384	100	
Ownership of Transport:			
Ownership of Transport:	Frequency	Valid Percent	Cumulative Percent
Yes	194	50.5	50.5
No	190	49.5	100
Total	384	100	

3.3. Inferential Results

The correlation and regression analysis were used to test the research questions that the market access factors influence commercialization of smallholder dairy value chain development which is measured by the average Household Commercialization Index. The results from the correlations, regression and HCI analyses are shown in tables 2, 3 and 4 respectively and discussed as follows:

3.3.1. Correlation Results

With respect to type of road accessible to the respondents, correlation results of a Pearson correlation coefficient of 0.780 and Spearman's rho of 0.689 shows that there is a positive relationship between type of road and the average Household Commercialization Index. The coefficients are highly significant at 1%. According to good road network accessible to the respondents, correlation results of a Pearson correlation coefficient of 0.768 and Spearman's rho of 0.774indicates that there is a positive relationship between good road network and the average Household Commercialization Index. The coefficients are highly significant at 1%.

The correlation results of a Pearson correlation coefficient of -0.854 and Spearman's rho of -0.773 indicate that there is negative relationship between distance to market and the average Household Commercialization Index with the coefficients being significant at 1%. According to correlation results of a Pearson correlation coefficient of 0.790 and Spearman's rho of 0.850, there is a positive relationship between availability of electricity and the average Household Commercialization Index. The coefficients are highly significant at 1%.

The correlation results of a Pearson correlation coefficient of 0.974 and Spearman's rho of 0.899 shows that there is a positive relationship between respondents' access to market information and the average Household Commercialization Index. The coefficients are highly significant at 1%. According to correlation results of a Pearson correlation coefficient of 0.962 and Spearman's rho of 0.754, there is a positive relationship between respondents' access to credit and the average Household Commercialization Index with the coefficients being highly significant at 1%.

The correlation results of a Pearson correlation coefficient of 0.676 and Spearman's rho of 0.627 indicates that there is a positive relationship between respondents' access to input and the average Household Commercialization Index with the coefficients being highly significant at 1%. As concerns correlation results of a Pearson correlation coefficient of 0.598 and Spearman's rho of 0.605, there is positive relationship between respondents' milk quality tested and the average Household Commercialization index with the coefficients being highly significant at 1%.

According to correlation results of a Pearson correlation coefficient of -0.776 and Spearman's rho of -0.618, there is a negative relationship between respondents' cost of transport and the average Household Commercialization Index with

the coefficients being highly significant at 1%. The correlation results of a Pearson correlation coefficient of 0.720 and Spearman's rho of 0.687 shows that there is a positive relationship between respondents' level of value addition of milk and the average Household Commercialization Index. The coefficients are statistically significant at 1%. According to correlation results of a Pearson correlation coefficient of 0.809 and Spearman's rho of 0.868, there is a positive relationship between respondents being member of farmer organization and the average Household Commercialization Index. The coefficients are highly significant at 1%.

As per the ability to speak/understand English, correlation results of a Pearson correlation coefficient of 0.271 and Spearman's rho of 0.310 indicates that there is a positive relationship between respondents' ability to speak/understand English and the average Household Commercialization Index with the coefficients being significant at 5%. According to the ownership of transport, correlation results of a Pearson correlation coefficient of 0.514 and Spearman's rho of 0.560 shows that there is a positive relationship between respondents' ownership of transport and the average Household Commercialization Index with the coefficients being significant at 5%.

Table 2. *Correlation results of the market access factors.*

| No. | Independent Variable | Correlation Model | |
		Pearson Correlation	Spearman's rho
1	Type of road used	.780**	.689**
2	Road network	.768**	.774**
3	Distance to market (Km)	-.854**	-.773**
4	Availability of electricity	.790**	.850**
5	Access to market information	.974**	.899**
6	Access to credit	.962**	.754**
7	Access to inputs	.676**	.627**
8	Milk quality	.598**	.605**
9	Cost of transport	-.776**	-.618**
10	Level of value addition	.720**	.687**
11	Member of farmers' organizations/institution	.809**	.868**
12	Ability to speak/understand English	.271*	.310*
13	ownership of transport	.514*	.560*

Key to Table 2:** Correlation is significant at the 0.01 level (2-tailed).*Correlation is significant at the 0.05 level (2-tailed). Sample size, N = 384. Correlation between each variable and itself = 1.00.

The correlation coefficients indicate that the average Household Commercialization Index of the respondents is significantly correlated with the independent variables. However, some correlations are more powerful statistically at 1% level of significance than the others at 5% level. Type of road; road network; distance to market; availability of electricity; access to market information; member of farmers' organizations/institutions; access to credit; access to inputs; milk quality; cost of transport; level of value addition have correlation coefficients greater than 0.7 (+ or -) and they are significant at 99% confidence level. On the other hand,

ability to speak/understand English and ownership of transport have low Pearson coefficients of 0.271 and 0.514 respectively at α = 0.05.

3.3.2. Regression Results

The regression coefficients in table 3 below show that the market access factors influence the average Household Commercialization Index (HCI) at various levels. The type of road has a standardized coefficient of 0.128 meaning that good type of roads accessible by the respondents is positively associated with Household Commercialization Index with coefficient being highly significant at 1%. One percent changes in the good type of road causes increase in the Household Commercialization Index by 0.128 (12.8%). The results of regression show that good road network has a standardized coefficient of 0.108, meaning that good road network accessible by the respondents is positively associated with higher Household Commercialization Index and, coefficient is significant at 1%. This makes the dairy products to easily reach the market at low cost mainly via an alternative road. One percent increases in good road network causes an increase of the HCI by 0.108 (10.8%). The regression results indicate that distance to market has a standardized coefficient of -0.190, meaning that respondents who are nearer to the market are negatively associated with Household Commercialization Index and, coefficient is significant at 1%. One percent increases in distance to market reduces HCI by 0.190 (19%).

According to regression results, the availability of electricity has a standardized coefficient of 0.128, meaning that respondents who were accessible to electricity are positively associated with Household Commercialization Index and, coefficient is significant at 1%. One percent increases in the availability of electricity, increases the HCI by 0.128 (12.8%). Regression results show that access to market information has a standardized coefficient of 0.210; implying that respondents who were accessible to market information are positively associated with Household Commercialization Index and, coefficient is significant at 1%. One percent increase in access to market information causes an increase of HCI by 0.210 (21%).

According to results of regression, access to credit has a standardized coefficient of 0.208, implying that respondents who were accessible to credit are positively associated with Household Commercialization Index with coefficient being significant at 1%. One percent increases in access to credit causes an increase of HCI by 0.208 (20.8%).

The regression results show that access to input has a standardized coefficient of 0.085, meaning that respondents who were accessible to inputs are positively associated with Household Commercialization Index and, coefficient is significant at 1%. One percent increases in access to inputs causes an increase of HCI by 0.085 (8.5%). The results of regression indicate that milk quality tested has a standardized coefficient of 0.026 meaning that respondents who had their milk quality tested are positively associated with Household Commercialization Index and, coefficient is significant at

1%. One percent increases in milk quality tested causes an increase of HCI by 0.026 (2.6%). According to regression results, cost of transport has a standardized coefficient of -0.105 meaning that r costs of transport are negatively associated with Household Commercialization Index and, coefficient is statistically significant at 1%. One percent increases in the cost of transport causes reduction of HCI by 0.105 (10.5%).

The results of regression indicate that level value addition of milk has a standardized coefficient of 0.095 meaning that respondents who value added their milk are positively associated with Household Commercialization Index. The coefficients are significant at 1%. One percent increases in value added product causes an increase of HCI by 0.095 (9.5%). The regression results show that being member of farmer organization has a standardized coefficient of 0.145, implying that respondents who were members of farmer organizations are positively associated with Household Commercialization Index and, coefficient is significant at 1%. One percent increases in being member of farmer organization increases HCI by 0.145 (14.5%).

The results of regression show that ability to speak/understand English has a standardized coefficient of 0.006 implying that having ability to speak/understand English is positively associated with Household Commercialization Index and, coefficient is significant at 5%. One percent increases in ability to speak/understand English causes an increase of HCI by 0.006 (0.6%). Finally, regression results show that ownership of transport has a standardized coefficient of 0.016 implying that owning transport is positively associated with Household Commercialization Index and, coefficient is significant at 5%. One percent increases in ownership of transport causes an increase of HCI by 0.016 (1.6%).

Table 3. Regression results of market access factors.

Variables	Coefficient	Std. Error	T-ratio
Type of road used	.128**	(.076)	1.632
Road network	.108**	(.112)	0.964
Distance to market (Kms)	-.190**	(.227)	-0.837
Availability of electricity	.128**	(.076)	1.684
Access to market information	.210**	(.134)	1.567
Access to credit	.208**	(.215)	0.967
Access to inputs	.085**	(.111)	0.766
Milk quality	.026**	(.076)	0.342
Cost of transport	-.105**	(.104)	-0.668
Level of value addition	.095**	(.193)	0.492
Member of farmers' organizations/institution	.145**	(.136)	1.066
Ability to speak/understand English	.006*	(.032)	0.188
Ownership of transport	.016*	(.100)	0.160
Constant	.285	(0.063)	0.450

** Coefficient is significant at the 0.01 level (2-tailed). *Coefficient is significant at the 0.05 level (2-tailed). Sample size, N = 384. R=0.839; R^2=0.704; Adjusted R^2=0.657.

The regression coefficients show that these market access factors (independent variables) influence the average Household Commercialization Index. The coefficients of

type of road used; road network; availability of electricity; access to market information; access to credit; access to inputs; milk quality; level of value addition and member of farmers' organizations/institution are statistically significant at 1% and positively related to the HCI. The coefficients of distance to market (Km) and cost of transport are significant at 1% and negatively related to HCI. Furthermore, ability to speak/understand English and ownership of transport coefficients are statistically significant at 5% and positively related to HCI. The R Square statistic (0.704) is generally interpreted to mean that the ten independent variables (market access factors) in the regression model account for 70.4 percent of the total variation in the given HCI." The higher the R-squared statistic, the better the model fits the data. In this case, the model fits our data with a high significance. The Adjusted R Square statistic (0.657) is a modified R-Square statistic that takes into account how many variables are included in the model. It is a common practice to say that one regression model "fits" the data better than another regression model if its adjusted R-square statistic is higher hence the data shows positive significance in relation to the study.

3.3.3. Market Access Factors and HCI Results

The HCI of the respondents were determined and the results as indicated and discussed (table-4). Results show that respondents who were accessible to tarmac roads have higher commercialization index of 71%, whereas those who were only accessible to earth roads have lower commercialization index of 25%. Murram road has HCI of 30%. The results therefore mean that Poor state of roads as well as inadequate road networks obviously hinders marketing efficiency hence low level of HCI. Earth roads usually become impassable during rainy seasons hence outputs not easily reach the markets. Likewise, inputs are also not easily being obtained from the markets. The low levels of HCI are mainly due to milk not reaching the markets and inputs not obtained easily from markets leading to low milk sales, high input costs and high transport costs. Low prices are disincentive to market participation and hence lowering household commercialization index. Inadequate transportation infrastructure raises search and monitoring costs. There are high post-harvest losses in poorly developed market infrastructure. In villages with bad market access due to poor roads, many producers incur high perishability and transportation costs. The lack of roads or presence of seasonally impassable or poor maintained roads influences market access.

The result is consistent to the findings of [23] in South Africa that infrastructural obstacles such as poor state of roads as well as inadequate road networks obviously hinder marketing efficiency. They also reported that remote locations of farms coupled with poor road infrastructure results in high transport costs and in cases where buyers provide transport, this further reduces the price that buyers are prepared to pay the dairy producers. According to [20] dairy producers in villages with bad market access in Kiambu

experience delayed milk collection and delayed payments. According to [12], producers who live next to better roads and have more frequent direct contact with the market are willing to produce more systematically for the market, while those with poor market access are forced to produce for domestic consumption. In the highland maize belt of Kenya and Tanzania, chronic poverty is not strongly linked to farm size but is concentrated among food crop producers in remote areas with poor road access. One study in Tanzania has estimated that households within 100 meters of a gravel road, passable 12 months a year with a bus service earn about one third more per capita than the average. In Africa villages with better physical infrastructure have fertilizer 14% lower, wages 12% higher and crop production 32% higher villages with poor infrastructure. In 1995, Uganda successfully negotiated for a World Bank loan to build new roads rather than new primary schools, arguing that new road should immediately raise national income and alleviate poverty in the short term. In 1996, the construction of a road from a village to the market Centre in Nigeria provided the impetus to increased production. In Sargodha district, Pakistan, unemployment decreased when new road created opportunities for drivers, conductors, mechanics, filling stations, shops, tea-stalls near bus stops and other services for travelers. In Sri Lanka, feeder roads in Kegalle had a positive impact on rural development. Construction and maintenance of rural roads can have important effects on incomes and livelihoods of the rural poor. [12], found out in Juncal, Ecuador that farmers without roads do not have a way out. These findings further support the study finding. According to Smallholder Dairy Commercialization Program [8], milk losses as a result of poor infrastructure were as high as 2,686,847 litres worth KES 53,736,940.00 per year hence supporting the study findings.

Respondents who were accessible to good road network have higher commercialization index of 59%, whereas those who were not have lower commercialization index of 28%. This is because the dairy products can easily reach the market at low cost mainly via an alternative road hence higher HCI. The poor state of the rural network impedes the physical movements of goods and thereby the integration of rural markets. The study result is consistent with the findings of [23] in South Africa that inadequate and dilapidated state of the rural network impedes the physical movements of goods and thereby the integration of rural markets. Many rural roads are impassable, except by tractors, during rainy seasons. Chinese farmers living in rural areas close to cities with dense transport networks have higher incomes than those in remote locations. There is no economic prosperity on the areas that can be achieved if roads continued to be in dilapidated state. The finding is also supported by the finding of [20] that in Kiambu, the degree of farmer participation in the markets for all commodities is higher in the villages with well-maintained roads compared to the villages that have bad market access.

According to the HCI results, respondents who were 1-4km away from the market have higher commercialization index of 66%, whereas respondents who were over 20km

away from the market have lower commercialization index of 22%. The other HCI results are: 5-9 km away 49%; 10-14 km away 29% and 15-20 km away 28%. This implies that respondents who are nearer markets have higher HCI because they can get their outputs and inputs to and from markets at low cost and faster. It also means that the greater the distance to the market, the less likely the respondents' orientation towards commercialization. Furthermore, respondents further away from market places have lower market participation and thus market orientation. The farther away a household is from the market, the more difficult and costly it would be to get involved. Thus, the greater distance to the market increases transaction costs. The study finding is in conformity to that of [23] in South Africa that distance to market is considered as proxy for transaction costs and it negatively affects market participation and HCI. The result is also supported by findings of [20] that Kiambu District, which is closer to the main urban centre, Nairobi has a higher degree of commercialization than the far-flung Kisii District for the milk and kales investigated. The finding of this study is also comparable with the result of [1] in Abia State, Nigeria that revealed that distance to market was seen to be significant at one percent probability level but with a negative sign. By implication, it means the greater the distance apart to the market, the less likely the producers' orientation towards commercialization. Households further away from market places have lower market participation and thus market orientation. This result is also in line with previous studies like those of [21]. The finding is also supported by the finding of [12] that perishable nature of much agricultural produce from the rural poor in Ecuador, especially women, combined with lack of storage facilities and long distances to markets influence market access. The use of commercial inputs in India like fertilizers and pesticides generally decreases with distance to market.

According to the results, respondents who were accessible to electricity have higher commercialization index of 35%, whereas those who were not have lower commercialization index of 20%. This is because the respondents were able to preserve and do value addition to their produce hence able to access market for increased HCI. It is envisaged that household with electricity can conveniently undertake basic-post harvest activities such as refrigeration of farm output like milk and access markets with higher quantities of produce. According to [20], villages in Kiambu with well-maintained roads and good access to electricity had higher marketed outputs of milk than areas that lack these characteristics. Market access was influenced largely by the state of the roads and the proportion of households with electricity in their homes.

Respondents who were accessible to market information have higher commercialization index of 69%, and those who were not have lower commercialization index of 26%. This is because the respondents who were accessible to market information were able to access a wide range of markets for the produce realizing increased income hence increased commercialization level. The more information the

household has on marketing, the less transaction costs will be thus increasing market participation. Smallholder dairy producers are often not aware of prices and market opportunities for their product and find it difficult to participate in alternative markets. Proximity to towns/cities is also proxy for access to information. Markets removed from major cities/towns are not well integrated in these markets, competition is often highly imperfect. Finding a buyer in these markets is often a problem. Lack of reliable information also hampers commercialization in areas with bad market access. The gradual shift to more profitable enterprises (dairy) in peri-urban areas could be due to the influence of better transport infrastructure, efficient information systems and higher degree of interaction in modern market outlets. The result conforms to the finding of [23] in South Africa that marketing efficiency is hindered not only by infrastructural factors but also by informational bottlenecks which increases transaction costs by raising search, screening and bargaining costs. A guaranteed market or contract farming is one of the institutional arrangements that can promote market access to emerging producers. Guaranteed markets impact positively on the HCI due to marginal cost associated with searching for the potential buyer. [15] argues that proximity to towns reflects how far producers have to travel to reach sources of information. Such information sources are located in nearest towns where there are offices and markets. The finding also conforms to [20] observation that remoteness restricts access to information about new technologies and changing prices, leaving the rural poor unable to respond to changes in market incentives. The findings on higher output sold from Kiambu than Kisii conform to [12] observation that remoteness restricts access to information about new technologies and changing prices, leaving the rural poor unable to respond to changes in market incentives. [22] found that facilitating market information provision via improved telecommunications is critical for increased market access. According to [12], the rural poor are constrained by lack of information about markets, lack of business and negotiating experience, and lack of a collective organization which can give them the power to bargain favorably. New information throughout the entire commercialization process may trigger key marketing strategy changes, or improvisation, in order to address the changing environment [12].

Results show that respondents who were accessible to credit have higher commercialization index of 59%, and those who were not have lower commercialization index of 27%. This is mainly because the respondents were able to increase their productivity through the use of available capital. The amount of dairy product sold should be understood in terms of the linkages that exist between input and output market. The unavailability of credit impacts negatively on the producers' ability to participate in the markets hence access to credit has a positive relationship with the level of market participation and HCI. Furthermore, credit is also one major constraint limiting market access, participation and the competitiveness of the industry. Credit

plays a vital role in the process of commercialization by allowing smallholder dairy producers to assume risks associated with commercial dairy production. Lack of credits has been noted as one of the major constraints militating against agricultural productivity among smallholder producers. Credits are expected to enhance producers skills and knowledge, link producers with modern technology through purchase of inputs, pay wages, invest in machinery, or to smooth consumption as well as markets, ease liquidity and input supply constraints, thus are expected to increase agricultural productivity, induce market orientation and participation and thus greater commercialization. According to [24], unavailability of credit inflates transaction costs in both input and output markets. A number of theoretical studies suggest that credit indeed has a positive impact on smallholder producers [24], A study by [1] also found out that accessibility to credits by the producers was significant and positive at 10 percent level, thus positively influencing producers' orientation towards commercialization. [19] finding also indicated that in order to promote the commercialization of poultry sub-sector, producers' access to credit should be improved as this would help them increase their capital base and increase their number of birds because this variable was significant in influencing poultry output and level of commercialization. The poultry producers having access to credit are business-oriented and their level of commercialization is generally high. According to [3], the positive effect of participation in financial markets suggests the importance of credit in helping to boost production and consequently, smallholders' participation in output markets.

The HCI results indicate that respondents who were accessible to inputs have higher commercialization index of 58%, and those who were not have lower commercialization index of 27%. This is mainly because the respondents were able to increase their productivity through the use of productivity enhancing inputs and more market oriented smallholder dairy production. Household commercialization generally has a significant and positive effect on dairy production input use and productivity. This finding also conforms to that of [22] in which sources of inputs determine level of commercialization. [20] found that improved input access leads to increased productivity hence increased commercialization. [3] found in his study that there is strong evidence for the positive effect of improved access to factors of production as well as working capital for the purchase of inputs on farmers' marketing decisions. The result is also confirmed by that of [11] that found out that those material inputs are the major factors that influence changes in yam output in Delta state, Nigeria. According to [14] in estimating technical efficiency, outputs and inputs are intended to capture differences in managerial abilities and access to input and output markets that affect decision making. [25] reported that access to markets is useful in proving technical efficiency especially in zero grazing system that is associated with high input use. The finding is also in line with that of [9] and [26] that productivity growth will increasingly entail yield growth and or shifts to higher-returns activities,

involving more intensive use of productivity enhancing inputs and more market oriented patterns of crop production. [12] in his study in Accra, Ghana found out that variable inputs increase with increasing market access, though in some cases the differences are not statistically significant. Variations in the use of fertilizer, pesticides and high yielding varieties across market access groups' exhibit statistically significance at the 1% probability level. His partial analysis showed that the most important input variables that influence agricultural productivity in the area include the application of fertilizers, pesticides, high yielding varieties, market access and labor input. Improved market access increases agricultural productivity. [12] found out that farmers' inability to market produce means lack of income for production inputs.

The HCI results indicate that respondents who had their milk quality tested have higher commercialization index of 57%, and those who had not have lower commercialization index of 26%. This is due to fact that the milk whose quality is tested is able to meet standards of various markets with higher sale price hence higher commercialization level. The issue of product quality and sanitary and phyto-sanitary standards are critical in enabling the smallholder dairy producers to be part of the game trade. The result conforms with [13] recommendation that targeting the export market for process of smallholder commercialization, the issue of product quality, sanitary and phyto-sanitary standards, timely and regular supply, and volume need to be given emphasis in enabling the smallholder farmers to be part of the game. According to [4], milk testing and quality control is an essential component for the successful development of competitive dairy industry value chain.

Respondents who had zero cost of transport of produce have higher commercialization index of 44%, and those who had cost of transport of Ksh 1100.00-3,000.00 have lower commercialization index of 24%. The other HCI results are as follows: Ksh 20.00- 100.00 30%; Ksh 150.00-300.00 29%; Ksh 300.00-600.00 27% and Ksh 700.00-1000.00 25%. The respondents with zero cost of transport have higher HCI mainly due to reduced cost of transport of either produce or inputs. This is mainly because the respondents' incomes from the sales of the product reduced with the increase of cost of transport of either produce or inputs. High transport costs, arising from lack of well-maintained roads, long distances and lack of affordable, appropriate transport create large physical constraints on market access by rural poor communities. Difficult market access restricts opportunities for income generation. Remoteness increases uncertainty and reduces choice. This weakens incentives to participate in the monetized economy, and results in subsistence rather market-oriented production systems. This finding is in conformity to that of [20] that proportions of marketed output for milk in both Kisii and Kiambu districts showed an increasing trend. This could be explained by reduced transport costs to market outlets. The gradual shift to more profitable enterprises (tomatoes, dairy and kales) in peri-urban villages could be due to the influence of better transport infrastructure,

efficient information systems and higher degree of interaction in modern market outlets. According to [12], low population densities in rural areas, remoteness from centres and high transport costs present real physical barriers in accessing markets.

According to the HCI results, respondents who carried out value addition of milk have higher commercialization index of 59% while those who did not have lower commercialization index of 23%. This is because the respondents value added dairy products attract higher prices hence higher HCI. Value addition reduces perishability and increases farm gate prices hence increased commercialization. This finding is in line with that of [20] that value addition reduces perishability and increases farm gate prices hence increased commercialization. According to [4] and [6] Kenya will raise income in Livestock through processing and adding value to her products before they reach the market.

According to the results of HCI, respondents who were members of farmer organizations/institutions have higher commercialization index of 56% whereas those who were not have lower commercialization index of 27%. This is mainly due to the fact that respondents who were members of farmer organizations were able to benefit from economy of scale through access to inputs at lower costs, access to market information and access to wide range of markets leading to better prices hence increased commercialization levels. In addition, collective action has an additional advantage of spreading fixed transaction costs. This variable impacts positively on market participation and HCI. Cooperation with large commercial producers also lowers transaction costs as it enhances opportunities for information sharing. The large scale commercial producers have access to services and profitable markets. This is a valuable resource that can promote market participation and increases HCI. The farmer's membership to associations' increases commercialization because membership of associations and groups possess the potentials of increased access to information important to production and marketing decisions. It is through networks that information and other resources can be transmitted, and the existence of trust facilitates co-operative behavior based around these networks. The result is in line with that of [16] that collective action as measured by belonging to farmers' organizations strengthens farmers' bargaining and lobbying power and facilitates obtaining institutional solutions to some problems and coordination. The result is also supported by that of [2] which state that membership of cooperatives had a positive sign indicating that as membership of cooperatives is increased and the encouraged commercialization of households will also increase. This is also in line with [2] where increase in membership of cooperatives increased fish production in the fresh water fishery sub-sector of the cross River Basin in Cross River State, Nigeria. According to [1], the coefficient of farmer's membership to associations was positive and significantly related to market orientation and commercialization at 1% probability level. The development

of agricultural support services such as agricultural extension linking smallholders with new farm practices, and institutional arrangements such as agricultural marketing and service cooperatives which are designed to help link smallholders with input and output markets [13] and [12] found that reducing transaction costs require arrangements that include contract farming and development of smallholder organizations to achieve continuous and reliable supply of marketed commodities.

The HCI results indicate that respondents who had the ability to speak/understand English have higher commercialization index of 46% whereas those who had no ability have lower commercialization index of 24%. This is because the respondents were able to access market through access of market information resulting to higher HCI. The likelihood of commercialization increases with the producers' ability to speak/understand English because inability to speak/understand English prevents a resource poor smallholder dairy producer from successfully engaging in trade, especially outside his/her settlement. Lower levels of literacy; generally make producers to have less access to land and credit hence low productivity and lower commercialization level. [23], found out that ability to speak/understand English has a positive effect on the level of HCI. Such producers would face high transaction costs in both factor and product markets outside their own area [16]. According to [12], market access problems can affect areas (due to remoteness or lack of infrastructure) and groups, such as the illiterate or poorly educated, minority ethnic groups or those not speaking the official national language, and women. In large parts of Latin America, indigenous people are concentrated in rural areas, and have higher incidences of poverty, lower levels of literacy and generally less access to land and credit. In other regions, remoteness combines with ethnic and language barriers to restrict market access, especially to labor markets.

According to the results of HCI, respondents who owned transport have higher commercialization index of 44% whereas those who did not own transport have lower commercialization index of 23%.

This is mainly due to the fact that respondents who own transport were able to transport products on time to the market before losing value and at lower cost leading to higher levels of commercialization. The crux of the matter is that ownership of productive assets in particular makes a household less vulnerable to shocks and extent of vulnerability determines household market participation. Thus, highly vulnerable households are expected to have lower commercialization index. In essence, it is primarily those who are relatively well endowed with agricultural capital who commercialize. Households with own transport are likely to transport their produce on time to the market before losing value. Such household will have higher levels of commercialization. This implies that households that own transport are more likely to be commercial smallholders that those without. [10] argues that assets empower the rural poor by increasing their incomes, reserves against the shock and

choices to escape from harsh and exploitative conditions. The finding of this study confirms that of [23] that found that

ownership of transport is significant and has positive influence on the level of market participation.

Table 4. Household Commercialization Index (HCI) results.

Access to good type of road			
Access to good type of road:	Frequency	Valid Percent	Average Household commercialization index
tarmac	15	3.9	71
earth road	249	64.8	25
murram	120	31.3	30
Total	384	100	42
Access to good road network			
Access to good road network:	Frequency	Valid Percent	Average Household commercialization index
Yes	141	36.7	59
No	243	63.3	28
Total	384	100	43.5
Distance to market (Km):			
Distance to market (Km):	Frequency	Valid Percent	Household commercialization index
1.00 – 4.00	89	23.2	66
5.00 – 9.00	77	20.1	49
10.00 – 14.00	45	11.7	29
15.00 – 20.00	61	15.9	28
Above 20km	112	29.1	22
Total	384	100	38.8
Availability of electricity:			
Availability of electricity:	Frequency	Valid Percent	Average Household commercialization index
Yes	139	36.2	35
No	245	63.8	20
Total	384	100	27.5
Access to market information			
Access to market information:	Frequency	Valid Percent	Average Household commercialization index
Yes	134	34.9	69
No	250	65.1	26
Total	384	100	47.5
Access to credit			
Access to credit:	Frequency	Valid Percent	Average Household commercialization index
Yes	159	41.4	59
No	225	58.6	27
Total	384	100	43
Access to input			
Access to input:	Frequency	Valid Percent	Average Household commercialization index
Yes	134	89.9	58
No	255	10.1	27
Total	384	100	42.5
Milk Quality Tested			
Milk Quality Tested:	Frequency	Valid Percent	Average Household commercialization index
Yes	179	46.6	57
No	205	53.4	26
Total	384	100	27.7
Cost of transport in Ksh/month			
Cost of transport in Ksh/month:	Frequency	Valid Percent	Average Household commercialization index
0	10	2.6	44
20.00 -100.00	109	28.4	30
150.00 -300.00	30	7.8	29
300.00 – 600.00	60	15.6	27
700.00-1000.00	55	14.3	25
1100.00 – 3000.00	115	31.3	24
Total	384	100	29.8
Value addition			
Value addition	Frequency	Valid Percent	Average Household commercialization index
Yes	125	32.6	59
No	259	67.4	23
Total	384	100	41
member of farmer organization:			
Member of farmer organization:	Frequency	Valid Percent	Average Household commercialization index
Yes	258	67.2	56
No	126	32.8	27
Total	384	100	41.5
Ability to speak/understand English			

Access to good type of road			
Ability to speak/understand English:	Frequency	Valid Percent	Average Household commercialization index
Yes	235	61.2	46
No	149	38.8	24
Total	384	100	35
Ownership of Transport			
Ownership of Transport:	Frequency	Valid Percent	Average Household commercialization index
Yes	194	50.5	44
No	190	49.5	23
Total	384	100	33.5

The HCI results for the market access factors range from 27.5% (subsistence) to 47.5% (semi-commercialized). This means most of the respondents are not commercialized due to lack of market access. Hence there need to improve market access for the smallholder dairy producers for sustainable development.

4. Conclusion and Recommendations

The study results have shown that the market access factors particularly access to good type of road; access to good road network; distance to market (Km); availability of electricity; access to market information; access to credit; access to input; milk quality tested; Cost of transport per month (Khs); value addition and member of farmers' organizations/institution have highly significant influence on commercialization of smallholder dairy value chain development. In view of the above results, the National and County Governments in consultation with other relevant stakeholders in the dairy value should formulate policies, and plan projects and programs that encourage more investments in rural infrastructure, create markets where none exist in order to reduce distance to markets, support provision of post-harvest storage facilities nearer to the producers, knowledge management and information provision, improve farmers' access to credit, improve input access leading to increased productivity, develop strategy for milk testing and quality control, and strengthen farmers' organizations so as to increase the bargaining and lobbying power; reduce wastage and transaction costs in the commercialization process. Furthermore, in the implementation of the formulated policies and the planned programs and projects transparency and accountability mechanisms should be at the centre of the implementation regulatory and legal frameworks.

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