ABSTRACT
Livestock production contributes significantly to the development of the Kenyan economy. In West Pokot County, agriculture and livestock account for 84% of the county’s economy. It is expected to be the county’s main driver to sustainably achieve a 10% annual economic growth rate and 30% poverty reduction by 2030. Dairy farms in South and West Pokot Sub Counties have been unable to achieve maximum production. This has led to a reduction in smallholder dairy farmers’ livelihoods. They have become vulnerable in terms of food and income security and hence have been unable to gather for their daily needs. Therefore, the objective of this study was to analyse farm specific socio-economic factors affecting milk production among smallholder dairy farmers in West Pokot County, Kenya. The study adopted descriptive and cross-sectional research. Data was collected from a sample of 383 smallholder dairy farmers from four wards in two sub-counties of South and West in West Pokot County, complimented with interviews from 11 key informants. A questionnaire and an interview schedule were used to collect primary data from the dairy farmers and key informants, respectively. Summary statistics showed that the average age of the respondents was 45.6 years who owned on average five dairy cows that produced 7.3 l of milk/cow/day. The fitted multiple regression model showed that age, family size, experience and main occupation had a significant impact on milk production at 1%, 5% and 10% significance levels respectively. A unit increase in family size, experience and main occupation of smallholder dairy farmer led to an increase in milk production by a coefficient of 87.64, 0.3911, and 13.45 respectively. An increase in farmer’s age by a 1 year led to reduction in milk production by 0.5193 l/cow/day. Therefore, both national and county governments should strategize ways of increasing experience through educative programs tailored towards more skills and technologies tailored towards increased milk production. Moreover, smallholder dairy farmers should be motivated towards investing and wholly dedicated to dairy farming; through constant and favourable milk prices. In addition, the youth and energetic smallholder dairy farmers should be motivated to investing in dairy farming.

Keywords: Social Economic Factors, Milk production, West Pokot County

INTRODUCTION
Dairy cows are one of the most valuable and profitable assets for African farming families. Increased availability and consumption of milk in Africa could thus accelerate the achievement of the sustainable development goals (SDGs) and ensure a significant supply of a variety of macro and micronutrients that improve metabolic health, muscular health, muscular skeletal health, reduces dental caries, incidences of cardiovascular diseases, hypertension and type 2 diabetes (Hill, 2017). Furthermore, when well developed, dairy farming could improve food security and provide employment and income to millions of smallholder farm-families. It is suggested that the nature of the yield gap in the dairy sector of Africa provides opportunities to increase production past the current attainable yields despite the constraints being faced by the dairy sector (Mayberry et al., 2017). One of the major setbacks to development in Sub-Saharan Africa’s (SSA) dairy sector is the large number of local breeds with low milk-yielding capacity. Milk productivity of these local breeds has been below 200 l/cow/year against 12,500 l in...
Socio Economic Factors Affecting Milk Production among Smallholder Dairy Farmers in West Pokot County, Kenya.

East African countries have milk production levels ranging from 1-5 l/cow/day (Mkwizu et al., 2020) as compared to Israel with 42 l/cow/ day (Agritech Israel, 2018). There is a lot that is unexploited in East Africa, and thus given the right tools and opportunities, the east African dairy farmers can increase their incomes and contribute to the growth of the dairy market, hence this motivates my study.

Kenya has around 85% of the cattle population in East Africa, (Thorpe et al., 2000). There are over 1.8 million smallholder milk-producing households who own 1-3 cows. The Kenyan dairy industry specifically has contributed to 14% of the agricultural gross domestic product (GDP), 44% of the livestock sector GDP and 4% of the national GDP (KDB,2020), thus this sector is well poised to significantly contribute to the Kenya government’s Big Four Agenda items of food security and nutrition, universal health care, affordable housing and manufacturing.

Although livestock is an important sector, productivity in developing countries, including Kenya, is far below world averages and insufficient to meet rising demand (Sanchez, 2010). Dairy farming is the most important sector in West Pokot County’s economy, providing jobs and improved living standards. This is depicted by the county private and public investor’s efforts of heavily investing in the sector through capacity building of farmers, investing in dairy cooperatives, being involved in solving dairy challenges and much more (West Pokot CIDP 2018-2022). The estimated annual milk production for South and West Pokot sub-counties is approximately 6 million litres (West Pokot CIDP 2018-2022). Dairy cattle produce 56.4% of West Pokot’s milk production and are mainly raised in the highland areas of Kapenguria, Lelan and Tapach, where production is by small scale farmers who own on average five to ten cattle per farmer (West Pokot CIDP, 2018-2022).

According to a 2021 Kenya National Bureau of Statistics report, the poverty rate in West Pokot County was 61.4%. The county has recently implemented several poverty reduction strategies, but little progress has been realized. As a result, there is need for the county government to develop strategies to support the sub county economic growth. The potential strategies include motivating the youth and women to have an active participation in the livestock value chain and tailoring more trainings to the dairy farmers to ensure there is improved production and in the long run contribute to poverty and malnutrition reduction. Therefore, this study intended to fill this research gap by analysing the social economic factors in milk production among smallholder dairy farmers in South and West Pokot sub-counties, Kenya.

MATERIALS AND METHODS

Study Area and Research design
This study was conducted in West and South Pokot Sub Counties of West Pokot County, Kenya, using a descriptive and cross-sectional survey research design.

Sample size and Sample Determination
A sample is a smaller group drawn from the population and can be used to generalize about the population (Kothari, 2004). The sample size determination was based on the formula provided by Yamane (1967) (Equation 1).

\[ n = \frac{\sqrt{N \varepsilon^2}}{1 + \sqrt{N \varepsilon^2}} \] ...........................(1)

where, \( n \) = sample size, \( N \) = population, \( \varepsilon \) = error term. A 95% confidence level was considered appropriate in this study. The values were then fitted into equation 1 as follows,

\[ n = \frac{8701}{1 + 8701(0.06)^2} = 383 \]

A total of 383 smallholder dairy farmers were selected for the study.

Sampling Procedure
Sampling, according to Orodho and Kombo, (2002), is the process of selecting the required individuals for the study, whereby several individuals are selected from a
population such that the selected group has elements representative of the characteristics found in the entire population. The purposive, two stage cluster and simple random sampling techniques were used. Firstly, purposive sampling was used to select the study sub-counties of South and West Pokot because dairy production is one of the major economic activities for majority of the people. West Pokot Sub-County has six wards namely, Riwo, Siyoi, Endugh, Sook, Mnagei and Kapenguria, while Pokot South Sub-County has two wards namely, Lelan and Tapach. Therefore, purposive sampling was used to select four wards with high number of dairy farmers in each sub-county. The selected wards were: Siyoi, Kapenguria (West Pokot) Lela and Tapach (South Pokot). Lastly, simple random sampling techniques was used to select the smallholder dairy farmers from the selected wards. A list of all smallholder dairy farmers from the selected wards in each of the two sub-counties was obtained from the Sub-County livestock office. The names of the dairy farmers in the lists were serially numbered and then randomly ordered and picked using a simple random sampling technique. This technique gave each farmer an equal opportunity of being selected and therefore, increased the chances of obtaining an appropriate and representative sample size. This was advantageous in the sense that the sampling frame was already available in the form of a list (Kothari, 2004). The sample size distribution is shown in Table I, proportional to size in each ward.

<table>
<thead>
<tr>
<th>Sub-County</th>
<th>Ward</th>
<th>Target Population</th>
<th>Proportion</th>
<th>Sample size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pokot South</td>
<td>Lelan</td>
<td>3,895</td>
<td>44.7650</td>
<td>171</td>
</tr>
<tr>
<td></td>
<td>Tapach</td>
<td>2,138</td>
<td>24.5719</td>
<td>94</td>
</tr>
<tr>
<td>Sub-Total</td>
<td>Siyoi</td>
<td>6,033</td>
<td>21.2619</td>
<td>265</td>
</tr>
<tr>
<td>West Pokot</td>
<td>Kapenguria</td>
<td>818</td>
<td>9.4012</td>
<td>36</td>
</tr>
<tr>
<td>Sub-Total</td>
<td></td>
<td>2,668</td>
<td>100</td>
<td>118</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>8,701</td>
<td>100</td>
<td>383</td>
</tr>
</tbody>
</table>

Source: Researcher’s Own Computation, (2021)

Key informants that included 10 officials of the dairy cooperatives, two Sub County Livestock officers and two extension officers (one from each sub-county) were sampled using purposive sampling technique.

**Data Types and Sources**

Primary data were collected directly from the smallholder dairy farmer household heads through personal interviews. Data on dairy farmers’ characteristics such as age, gender and family size, occupation, farming experience, educational level and income sources were collected.

**Data Collection Instruments**

Structured pre-tested questionnaire administered through direct interviews among the selected dairy farmers was used. Trained 11 enumerators assisted in data collection. An interview schedule was used to collect data from key informants.

**Validity of the Data Instruments**

According to Mugenda and Mugenda, (2003), validity alludes to the accuracy and meaning of realities and proof, which are drawn from the research results. It is how much outcomes acquired from the investigation of the information represent the subject under investigation. They argue, that an instrument is valid when it can measure what it purports to measure. According to Orodho (2009), before using a research instrument, content validity should be determined by the researcher, the researcher will discuss the items in the instrument with the supervisor and colleagues. The research instruments for this study were presented to two experts at the University of Eldoret to determine both content and face validity. The experts have a wide experience in teaching and supervising postgraduate students. Their comments were incorporated into the instruments.
Data Collection Procedures

The researcher then proceeded to make appointments with farmers before collecting the data. Household heads were interviewed, however, if not available, a spouse or a knowledgeable person of the household was interviewed.

Data Analysis and Presentation

For the determination and description of elements of independent variables on the dependent variable, descriptive and inferential statistics were used and results were presented in tables.

Farm specific socio-economic factors affecting milk production among smallholder dairy farmers in South and West Pokot Sub-Counties, Kenya, were estimated using a multiple regression model (equation 2).

\[ U_i = \beta_0 + \beta_1 z_1 + \beta_2 z_2 + \beta_3 z_3 + \beta_4 z_4 + \beta_5 z_5 + \beta_6 z_6 + \beta_7 z_7 + v_i \]

Where \( U_i \) = Milk production in litres
\( \beta_1 \ldots \beta_7 \) = are the parameters of the model to be estimated
\( v_i \) = is the error that is independently and normally distributed
\( z_1 \ldots z_7 \) = are the values of explanatory variables such that:
- \( Z_1 \) = Age of the farmer (Years),
- \( Z_2 \) = Gender (Male=0, Female=1)
- \( Z_3 \) = Family size (Numbers)
- \( Z_4 \) = Occupation (dairy farming=0, crop farming =1, salaried employment =3)
- \( Z_5 \) = Farming experience (Years)
- \( Z_6 \) = Educational level (Literacy Level)
- \( Z_7 \) = sources of income (dairy farming = 0, crop farming = 1 and off farm = 2)

RESULTS AND DISCUSSIONS

Descriptive Analysis Results

The key descriptive analysis results discussed in this study include age, gender, household size, education levels of household head, years of experience and number of dependents (Table II).

From Table II of results, the mean household size was 7 members, with the range being from 1 to 28 members. Household size is a significant factor in labour utilization. It is believed that those depending on the household head will provide labour readily and cheaply thus lowering the production cost. As the family size increases, more labour is available for milk production, thus improving farm technical efficiency. The current results are almost similar to those of Tassew and Seifu (2009) who found the average household size to be 7.71 members in Ethiopia, and Odhiambo et al., (2019) who found the average household size to be 6.23 in Migori County. However, the current results are contrary to those of Banda et al. (2021) who found dairy farmer’s average household size to be five members.

Table II further shows that the minimum dependents that a household had was 3.4 and the maximum was 20. The average being 6. The number of dependents affects the household’s economic performance, since if the number of dependents are many, most of the income could be consumed instead of improving the dairy sector. Thus, reduces efficiency of milk production

Results of summary statistics as shown in Table II, shows

<table>
<thead>
<tr>
<th>TABLE II- SUMMARY STATISTICS OF HOUSEHOLD SOCIAL ECONOMIC FACTORS IN THE STUDY AREAS</th>
<th>Mean</th>
<th>Observations</th>
<th>S D</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of household members</td>
<td>7.2</td>
<td>383</td>
<td>2.9</td>
<td>1.0</td>
<td>28.0</td>
</tr>
<tr>
<td>Number of dependents</td>
<td>5.5</td>
<td>383</td>
<td>3.4</td>
<td>0.0</td>
<td>20.0</td>
</tr>
<tr>
<td>Age of the household head</td>
<td>45.6</td>
<td>383</td>
<td>11.9</td>
<td>23.0</td>
<td>80.0</td>
</tr>
<tr>
<td>Number of dairy cattle kept on the farm</td>
<td>5.1</td>
<td>383</td>
<td>3.6</td>
<td>1.0</td>
<td>26.0</td>
</tr>
<tr>
<td>Income earned per day from milk sales</td>
<td>305.8</td>
<td>383</td>
<td>328.6</td>
<td>0.0</td>
<td>2025.0</td>
</tr>
<tr>
<td>Average milk production</td>
<td>1.97</td>
<td>383</td>
<td>2.48</td>
<td>0.5</td>
<td>20</td>
</tr>
</tbody>
</table>

Source: Author’s Computation from Survey Data, 2021, S D – Standard deviation
that the mean age of the household head was 45.6. This is similar with the results by USDA, (2017), who found the mean age of the household head to be 46.3. However, these results were contrary to those of Maina (2018) who found the mean age of a dairy farmer to be 57 years. From a study by Banda et al. (2021) in Malawi, it was documented that, there were few young farmers involved in dairy and this could be due to lack of start-up capital and the high labour demand associated with the cut and carry dairy feeding systems that are used. This could be an indication of the need for deliberate mechanisms to stimulate more entrants into dairy farming and hence avert dwindling of number of farmers in dairy farming over time. For instance, tailor-made training for older dairy farmers to improve technical efficiency since technical efficiency of dairy farmers reduces with age where farmers below 40 tend to be better than those above 40 years (Stein and Amanda, 2015)

The results in Table II also show the mean number of dairy cattle kept on the farm is 5 that ranged from 5 to 26. From a study by Mugambi et al. (2014), it was found that with an increase in milking herd size by one unit, there was an increase in smallholder dairy farm performance by 6%. The more the herd size is increased the more there is increased milk production.

The results on gender of the smallholder milk farmer household head showed that, 89.3% of the household heads were male. This shows that the milk production in the study area was dominated by males, this implies that the gender distribution of the dairy farming households in the study area is not well balanced. These results concur with those of Wilkes et al., (2020) who reported that 85% of dairy farmers were male. From a study by Kimaro et al. (2013), regardless of female’s many responsibilities in dairy production, women have significantly less access to resources and services which impair their increased productivity and their income earning potential.

Table III of results shows the level of education of the respondents. From the results, 44.9% of the household heads had attained primary level of education, 30% secondary education level, 15.4% tertiary level, while 9.7% had no formal education. The results indicate that the highest percentage of the farmer households had attained the primary and secondary education as their basic education levels. This shows that farmers who have basic levels of education are more likely to be directly involved in dairy production, which is the main source of income in the rural areas. This result concurs with those of Koech, (2011) who found that in Baringo County, 49% of the respondents had secondary education followed by primary with 23%, while those with no formal education as well as those who had tertiary degrees were less involved in milk production. Formal education provides a route for the acquisition of useful knowledge on dairy production due to the ability to read and comprehend information on agricultural activities.

<table>
<thead>
<tr>
<th>Level of education</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>9.7</td>
</tr>
<tr>
<td>Primary</td>
<td>44.9</td>
</tr>
<tr>
<td>Secondary</td>
<td>30.0</td>
</tr>
<tr>
<td>Tertiary</td>
<td>15.4</td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: Author’s Computation from Survey Data, 2021

ECONOMETRIC ANALYSIS

Estimates of farm-specific Socio-Economic Factors Affecting Milk Production

Table V shows the coefficient of determination (adjusted $R^2$) that was computed to determine the degree to which the independent variables explained the variation in the dependent variable in the multiple linear regression model. The values for $R^2$ and Adjusted $R^2$ were 0.9245 and 0.9231, respectively. This means that our independent variables for the study explained over 92% of the variation in the dependent variable.

The results of the $F$-ratio test for the regression model. $F$ test of overall significance indicates whether the regression model provides a better fit than a model that contains no independent variables. From the results, the output shows that the independent variables statistically and significantly predicted the dependent variable, the $F$ statistic was 655.79, $p < 0.1$ According to the study by Paul et al. (2012), on standardizing the power of the Hosmer–Lemeshow goodness of fit test in large data sets, the regression model is statistically significant if the $p<0.0005$ or 0.0001. Therefore, the statistical significance of $p<0.0001$ obtained in this current study falls within the acceptable range of $p<0.0005$ or 0.0001. This indicates
that the overall regression model is a perfectly good fit for the data.

The $R$-square and $F$-test results explained above show that the independent variables are statistically significant with a high $R$-square value. This combination indicates that the independent variables are correlated with the dependent variable and explain more than 70% of the variability in the dependent variable.

From Table V, experience, age, occupation, and family size were found to be statistically significant at 5% level.

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Sum of squares</th>
<th>Degrees of freedom</th>
<th>Mean Sum of squares</th>
<th>$F$</th>
<th>Prob &gt; $F$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>7502335.7</td>
<td>7</td>
<td>1071762.24</td>
<td>655.79</td>
<td>0.0000</td>
</tr>
<tr>
<td>Residual</td>
<td>612862.794</td>
<td>375</td>
<td>1634.30078</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>8115198.5</td>
<td>382</td>
<td>21243.9751</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R-squared</td>
<td>= 0.9245</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>= 0.9231</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TABLE V- ESTIMATES OF SOCIAL ECONOMIC FACTORS ON MILK PRODUCTION

The result for farmers’ experience was found to be statistically significant at a 5% level with a positive coefficient of 0.3911. The positive coefficient shows that a one-year increase in the farmer’s experiences results in an increase in milk production by 39.11%. The reason is that as farmers’ experience increases, the technical know-how on dairy production advances thus leading to increased production. Similar results were found by Sultana et al. (2016) on a study on socio-economic determinants of milk production in Bangladesh: An implication of farm water use. Further the results concur with that of Gitau (2013) on a study on factors influencing milk production among small scale dairy farmers in Mirangine in Nyandarua County and Mauche in Nakuru County, Kenya. It was found that farmers experience had a positive impact on milk production, the more experienced a dairy farmer was, the more he/she applied best farm practices and consequently improved production.

Results reveal that the age of the smallholder dairy farmer household head was significant at 1% level with a negative coefficient of 0.5193. The negative sign of the coefficient shows that as the age of the household head increases by one year, there is a decrease in milk production by 51.93%. The negative impact associated with age on milk production may be explained by the fact that with time, the older household heads may be hesitant in adopting new milk production techniques that enhance milk production. Younger producers are more receptive to new production techniques hence standing a chance to produce more milk. This results differs with those of Ng’eno, (2019) in a study on determinants of farm-gate marketed milk output volumes in Kericho County, Kenya. By using Second-stage Heckman selection estimates, Ngeno’s results showed that an increase in age by one year led to a 6.3% increase in milk output, thereby increasing the probability of more milk produced per day. Also the findings differ with those of Kurma et al. (2013) in a study...
on factors affecting milk market participation and volume of supply in Ethiopia. The results indicate the age of the household head positively and significantly affected the probability of milk production.

The family size was statistically significant at 1% level with a positive coefficient of 87.641. This implies that an increase in family size by one member results in a probability increase in milk production by 87.641 l. This is due to increased labour force with no cost. Similar results were found by Ng’eno (2019), who found out that household size (total household members) had a significant positive effect on the milk volume produced. One additional member of the household results in a 6.5% increase in marketed milk output volume/day. He further added that though with increased family size, food security issue arises. The bigger the household size, the higher the possibility of improved benefits from the increased volume of milk output produced by households.

The main occupation was statistically significant at 10% level with a positive coefficient of 13.4479. This implies that those involved in dairy production as the main economic activity were more likely to have increased milk production by 13.45 l from their dairy cows. The reason is more time and effort will be used in improving milk production. The farmer will concentrate on maximising output by using the available resources thus also increasing farm efficiency. Similar results were found by (Maina, 2018) who found that dairy farming as the main economic activity results to increased economic efficiency, thus eventually increasing milk production.

CONCLUSIONS AND RECOMMENDATIONS

Regression results showed that age, farmers experience, family size and main occupation had a significant impact on milk production in West Pokot County. Farmers’ age reported a statistically significant value, indicating that as a farmer ages, he becomes less receptive to new technologies tailored towards increased milk production. The government in turn should find ways of increasing farmer’s knowledge and technologies by increasing the quality and quantity of trainings, increasing extension visits, and organizing field demo days. This will in turn motivate the farmers. A large family size, although it contributes positively to the production level in the short run due to increased labour productivity, it leads to a high dependence ratio in the long run. This therefore indicates that the economically active population and the overall economy face a greater burden to support the dependent people. This affects negatively the productive level in the long run. Therefore, proper policies should be sought to ensure there is increased labour productivity with reduced dependency ratio in the county. Prioritizing dairy farming as the main economic activity, led to a proportionate increase in milk production. Hence, proper policies and strategies should be put in place by the county and national governments to ensure more farmers consider dairy farming as the main economic activity. These policies and strategies should include availability of credit facilities, high and stable market prices, reliable artificial insemination services and animal health services, increased dairy farmer trainings, extension services, individual farm visits and good infrastructural facilities.

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