Determinants of Milk Supply to Formal Milk Markets among Dairy Farmers in Oyo and Kwara States, Nigeria

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Abstract

The Nigeria dairy sector is the largest producer of cow milk in West Africa. Despite its size, the current milk production does not meet the annual market demand of 1.45 billion litres. This study was therefore designed to examine the determinants of milk supply by local dairy farmers to formal milk market in Kwara and Oyo States, Nigeria. The specific objectives of the study were to; examine the major factors influencing milk supply to the milk collection centers in the study area and to identify the constraints of milk supply to the formal market by the small scale milk farmers in the study area. Purposive and random sampling techniques were employed in selecting 238 respondents. The research instrument used was the interview schedule. The analytical tools employed were descriptive statistics, multiple regression analysis and likert type scale. The study showed that the determinants of milk supply to the milk collection centers by small-scale dairy farmers were distance to the collection centers, number of lactating cows, number of cattle, price of milk at the collection centers, years of dairy farming experience and access to market information. While lack of suitable breeds, cost of production, inadequate water supply, lack of milking parlor and inadequate credit, were the constraints facing the small-scale dairy farmers. The study therefore recommends that increase in use of modern production and processing technologies and genetic improvement of the local breeds should be encouraged for increased supply of milk to the formal milk markets.

Introduction

The global demand for milk and dairy products is increasing rapidly, due to the growing world population combined with urbanization, shifts in dietary patterns and income growth (IFCN, 2013; Migose et al. 2018; Vroegindewey, et al., 2021). Milk and dairy products play important roles in consumer'sdiet which contributes to their healthy living (RIM, 2013). According to FAO (2013), World milk production in 2015 stood at 930 million tonnes. United States and India has been identified as the top two milk producing countries, with annual production levels estimated at 92 million MT and 61 million MT respectively. In Africa, Kenya and Ethiopia takes the lead with an annual production of 5.2 million MT and 4.0 million MT of milk respectively (Sahel Analysis, 2019). However, Africa accounts for just over 2 percent of world milk production. In the year 2015, total cow milk production in Africa was 41,244,474 tonnes produced from a total of 86 million cows, giving an average milk yield of 661 kg milk per cow over the year, which is only one fifth of the world's average yield (FAO, 2013).

There is a slow overall growth in milk production in Africa. Individual countries have witnessed different growth and reduction rates, between 2004 and 2012. Remarkable increasing

trends (>5% /year) were noticed in countries like Egypt, Ethiopia, Uganda, Namibia and Nigeria (LRRD, 2012). One of the most prominent trends is the increasing importance of developing countries in the supply and demand for dairy products. (Aboki et al., 2019).

Nigeria is the largest producer of cow milk in West Africa and third in Africa and holds the 57th position in the world in terms of cow milk production. The Nigerian dairy sector is largely fragmented, unproductive and inefficient despite its size. The smallholder dairy households (i.e. pastoralists) produce most of the raw milk in Nigeria. About 95% of the raw milk is produced by these pastoralists who are nomadic. Nigeria milk production in 2015 stood at about 918,356 tonnes, with cow milk accounting for 98 percent of this production (Ali & Uche, 2016). The relatively low milk yield in the country is associated with animal breed which has contributed to the shortage in cow milk supply in Nigeria (Tewe&Boganga, 2016). Although milk production per cow has increased in the last ten years in Nigeria, milk production per cow is still rather low compared to that of European, Union (EU) countries (NLPD, 2016). In addition, the growth in milk production has been insufficient to meet consumption level (FAO, 2012) therefore the country is a net importer of the product (Aboki et. al., 2019). Nigeria relies heavily on imported milk powder to satisfy the consumer demand for milk and milk product.

The gap between local supply and demand for milk is widening (Yahuza, 2012). Imports that bridges this gap is declining as a result of reductions in the importation of milk powder and butter oil. Therefore, the milk industry is facing a serious challenge of meeting the daily nutritional requirement of Nigerians (William, 2013). Consequently, local collection, processing and marketing of milk is becoming increasingly competitive (FAO, 2013).

Table 1: Annual Demand and Supply of Milk in Nigeria (2000-2012)

Year	Demand (tonnes)	Supply (tonnes)
2000	990,000	495,479
2001	1,014,750	515,291
2002	1,040,004	535,911
2003	1,066,050	557,347
2004	1,092,780	579,641
2005	1,120,005	606,827
2006	1,147,230	634,013
2007	1,174,432	662,742
2008	1,201,637	691,842
2009	1,228,910	721,952
2010	1,256,464	753,077
2011	1,284,018	785,231
2012	1,425,228	818,356

Source: Nigeria Livestock Subsector Review Report, 2012.

Nigeria is a potential market for 1.3 million tons of milk valued at about N450 billion annually (FAO, 2012). Of the estimated total domestic fluid milk production in 2012, only about 15 percent (worth about N432.5 million) entered formal marketing channels through corporate, public and other private milk collection co-operatives schemes from migrant herdsmen and the output of the few commercial dairy farms. The rest was either consumed by the producing families or traded informally within the producing communities in form of cheeses and Nunu (FAO, 2012). In 2017, Nigeria imported about N82.8 billion worth of dairy products, which accounted for 2% of the country's total import bill for that period.

The Nigerian formal milk market is dominated by a few multinational companies, prominent among which is Friesland Campina WAMCO (FCW). This domination by multinational companies has inflationary and food security risk tendencies to the country. Although, Friesland Campina, finishes its milk products in Nigeria, its raw materials are imported in powdered form from other countries (IFDC, 2012). Such import is subjected to world market prices and as such may not reflect the current national market price. In addition, FCW is the only multinational currently sourcing raw milk locally. However, very few formal processors (multinational and local processors) use raw milk estimated at 5%, sourced locally in their products (Sahel Analysis, 2019). An inquiry is deemed necessary into the part of the local supply that is being met by the local milk producers. Therefore the objective of the study is to analyze the determinants of milk supply to formal milk markets among dairy farmers in Kwara and Oyo state of Nigeria and to identify the constraints of milk supply to the market by the small scale milk farmers in the study area.

Study Area

The study area is Oyo and Kwara state of Nigeria. The study area is bounded in the North by the Southern Guinea Savanna zone and in the South by the interface of lowland and rain forest. Kwara State lies between latitude $7^0$15E and $6^0$18N of the equator and covers a land area of about 32,500km^2 (Kwara State Ministry of Information, 2002). The mean annual rainfall is about 1500mm. The minimum average temperature throughout the state ranges between 21.1^{0}C and 25.0^{0}C.TheShonga farms are located in this state. These farms are, operated by thirteen foreign farmers. The farms are centered on three farming activities, mixed farming, dairy farming and poultry farming. Part of the thirteen farms is the five dairy farms, with a total of 2,000 cattle. The dairy farm produces about 7,500 litres of milk per day. The first Wamco Milk Collection started in August 2010 in Shonga dairies in Kwara State (IFDC,2014). The farm

supply fresh milk daily to Friesland Campina Wamco. Local farmers are also being integrated into the formal milk marketing of these white farmers in order to meet the demand and supply of fresh milk to Friesland Campina Wamco. The farmers are asked to bring their cows for milking every day and also by bringing their milk to the collection center for sale to Friesland Campina Wamco, (IFDC, 2014). The success of the milk collection and the need to meet fresh milk demand by Friesland Campina Wamco necessitated an expansion of operation area to Oyo state (IFDC, 2014).

Oyo State has two ecological zones (rainforest to the South and derived Savanna to the North). The annual rainfall ranges from1,200 – 1,300 mm. The temperatures vary from a minimum of 21°C in July to a maximum of 39°C in February. Oyo state has four Milk Collection Centers (MCCs). The Centers are located at Fashola, Alaga, Budo Musa and Maya. Over 300 milk farmers in this zone were registered and trained in raw milk hygiene and quality. The local milk farmers are now been integrated into the marketing chain by supplying fresh milk to the milk collection centers. Most of the milk produced in this area are done by the local Fulani farmers. These small scale dairy farmers supply fresh milk on daily basis to the milk collection centers and bulking centers in Iseyin and Fasola, The local Fulani milk farmers supply between 15,000 and 20,000 litres of fresh milk to Wamco on a daily basis (The Nation, 2014).

Sampling Procedure

A three stage sampling technique was used in selecting the respondents for the study. The first stage was the selection of Zone B in Kwara State and Oyo Zone in Oyo State. This selection is purposive because of the presence of milk collection centers in the Zone. The second stage was purposive selection of all the five milk collection centers identified in both Oyo and Kwara State of Nigeria. The third stage was the random selection of 250 dairy farmers from a list of 447 dairy farmers in the two zones. A structured questionnaire was used in collecting primary data from the selected respondents.

Analytical Techniques

Descriptive Statistics

These include percentages, mean, median, mode and standard deviation. This was used in describing the socio-economic characteristics of the dairy farmers in the study area. Descriptive tools were also used in presenting the results of the findings.

Multiple Regression

To determine the factors that influence the quantity of milk supply to the milk collection center the multiple regression was used. The implicit form of the regression analysis is expressed as follows:

$Y = F(K_1, K_2, K_3, K_4, K_5, K_6, K_7, K_8, K_9, K_{10}, U)$ …….. (1)
Where: Y = Quantity supplied (litres)
K_1= Distance to nearest milk collection centers (Kilometers)
K_2= Number of Lactating cows
K_3= Herd size
K_4= Price of milk (Naira)
K_5=Income from secondary sources (Naira)
K_6= Access to credit (1 =Access to credit and zero otherwise)
K_7= Gender of household head (1 = male and zero otherwise)
K_8 = Experience in dairy (Years)
K_9 = Household size
K_{10}= Access to market information(1 = access to market information and zero otherwise)
The four functional forms were fitted. They are linear, semi – log, double log and exponential. The one that gives the best fit will be selected based on econometric criteria. The equation is as follows:
Linear function:
$Y = b_0 + b_1K_1 + b_2K_2 + b_3X_3 + b_4K_4 + b_5K_5 + \ldots\ldots\ldots + b_{10}K_{10}$ (2)
Semi-Log function:
$Y = b_0 + b_1\log K_1 + b_2\log K_2 + b_3\log K_3 + b_4\log K_4 + b_5\log K_5 + \ldots\ldots + b_{10}\log K_{10}$ (3)
Double-Log function:
$\text{Log } Y = b_0 + b_1\log K_1 + b_2\log K_2 + b_3\log K_3 + b_4\log K_4 + b_5\log K_5 + \ldots\ldots\ldots\ldots + b_{10}\log K_{10}$ (4)
Exponential function:
$\text{Log } Y = b_0 + b_1K_1 + b_2K_2 + b_3K_3 + b_4K_4 + b_5K_5 + \ldots\ldots\ldots + b_{10}K_{10}$ (5)
The essence of these functional forms is to select the model that best fits the data in an effort to determine those factors that are significant in determining the milk supply to formal milk market.

Likert type

A five-point likert type was adopted in this study to analyze constraints facing the dairy farmers in the sampled area during the survey. A set of possible constraints were itemized and dairy farmers were asked to indicate their perceived level of severity of each of the constraints. The dairy farmers were also permitted to mention additional constraints and rate them according to their severity. The scale was ranged from extremely serious = 5, very serious = 4, moderately serious = 3, mild = 2, and not serious at all = 1, these values when added gives a value of 15, which was later divided by 5 to get a mean score of 3.0. The respondents' mean score was obtained on each of the items. Mean score ≥3.0 was regarded as being serious, while any mean

less than 3.0 was considered as not serious. Also, percentage rating of the constraints was also used to validate the results of the mean score.

Results and Discussion

Socio-economic Characteristics of the Farmers

Table 2 presents the socio-economic characteristics of the smallholder dairy farmers. The result showed that the mean age of the household head is 42.1 years. About 54 percent of the farmers are between the age of 31 and 50 years in the study area. Majority (90%) of the farmers had a household size of between one and ten members. This study records a mean household size of seven persons. The size of the household is relevant to family labour that would be used in dairy production.

Table 2: Distribution of Household Heads by Socio-Economic Characteristics.

Characteristic	Mean	Percentage
Age	42.1	54.20 (31 - 50 years)
Household size	7	89.90 (1 – 10 members)
Experience	24.2	41.23 (21 – 30 years)
Herd size	61.4	87.06 (1 – 100 herd size)
Primary Occupation (Pastoralist)		92.40
Secondary Occupation (Milk production)		95.84
Access to extension services		80.34 (have access)
Membership of agricultural organization		65.12 (members)
Access to market information		94.11 (have access)
Animal breed		99.21 (Indigenous/local breed)

Source: Researcher's Field Report, 2015

Farming experience showed that 41 percent of the respondents have been in dairy production for about 21 to 30 years with an average farming experience of 24.2 years. Milk production is an age long venture and family members are born into it. The size of herd is traditionally considered a measure of wealth and social status among the nomads; the larger the size of the herd of a nomad, the greater the security such an individual enjoys (Osotimehin.et al, 2006). The distribution of the number of cattle owned by the household heads revealed that about 87 percent of them had a herd size of between 1 and 100 heads of cattle, while the mean herd size was about 61 cattle. This suggests that the farmers were small-scale cattle rearers.

Majority of the household heads are pastoralists (92.4%). They are the most important source of domestic milk supply in Nigeria (Yahuza, 2001). These herdsmen practice a pastoralist type of management whereby cattle are held in the vicinity of the village or urban areas during the wet season and then taken to lower pastures during the hot months in search of better grazing area (Douffissa, 1993).

Majority of the respondents (80.3%) had access to extension services, about 65 percent of the farmers were members of agricultural organization while 94 percent of the farmers had access to market information. Majority of the farmers (99.2%) have indigenous breeds. This level of production could be attributed to the use of indigenous breeds of cattle, predominantly local breeds such as Bunaji (white Fulani) and some Rahaji and Sokoto Gudali which have poor genetic quality for milk production but has high resistant to diseases (Daniel, 2010). On the other hand, high-producing exotic breeds are few and are found mainly on commercial private farms under intensive management. These results are in conformity with the findings of previous studies on cattle breeds and dairy production among small and medium scale farmers in Nigeria (Daniel, 2010).

Factors Affecting Quantity of Milk Supplied to the Milk Collection Centers

This section presents the factors that determine quantity of milk supplied to the milk collection centers. Various variables are assumed to determine the quantity of milk supply to the milk collection centers by sampled dairy farmers. The four functional forms of the multiple regression model were estimated for the study. Correlation matrix was used to check autocorrelation among variables. According to the test results, autocorrelation was not a serious problem among the variables.

Table 3: Determinants of Quantity of Milk Supply to the Milk Collection Centers

Variables	+Double log	Linear	Semi log	Exponential
Constant	3.79	1.76	2.66	6.20
Distance to the milk collection centers	-0.46 (-9.48)***	-0.03 (-2.39)***	-0.18 (-3.78)***	-0.43 (-11.26)***
Number of lactating cow	1.52 (5.22) ***	-0.16 (1.94)***	1.84 (5.89)***	0 .32 (5.95)***
Number of herd	0.36 (6.89)***	-0.58(-42.8)***	-0.44 (-8.66)***	-0.45 (-10.77)***
Price of raw milk	1.16 (3.64)***	0.84(10.14)***	-0.33 (-3.27)***	0.01(1.19)
Income from secondary sources	-1.19(-.079)	0.02 (0.38)	0.04 (0.71)	0.11 (1.72)
Access to credit	-0.16 (-1.45)	0.03 (0.37)	-0.78(-2.65)***	-0.10 (-1.56)
Gender of the household head	-0.14 (-1.18)	-0.08(-7.04)***	-0.11 (-1.82)	-0.074 (-2.05) ***
Experience	0.075(1.960)**	-0.04 (-0.62)	0.16 (1.99)	0.08 (0.27)
Household size	1.27 (0.03)	-0.02 (-.029)	-0.017 (-1.18)	-0.04 (-0.72)
Access to market information	0.19 (4.59)***	-0.01 (0.09)	0.11 (1.67)	0.11 (3.51)***
R square(R^2)	0.69	0.57	0.67	0.50
Adjusted R square	0.68	0.568	0.66	0.50
F value	64.05	2053.17	97.36	134.07

+ lead equation ***Significant at 1 per cent level, **Significant at 5 per cent level. Note Figures in brackets are t-values. Source: Researcher's Field Survey, 2015

The results of the four functional forms run showed that the double-log function satisfies the econometric criteria for being chosen (Table 3). The selection was based on the values of R^2 (coefficient of multiple determinations) and F-statistics. The R^2 of 0.69 implies that about 69 percent of the total variation in quantity of milk supplied was explained by the explanatory variables. The F-ratio was 64.05 is significant at one percent level, implying that the joint effects of all the included variables were significant.

From the table, the coefficient of distance to milk collection center was negative and found to be statistically significant at one percent level of probability. This implies that the farther a household is from the milk collection centers, the more difficult and costly it would be to supply milk to the milk collection centers. This is in agreement with priori expectation. Increase in distance from the dairy farm to the milk collection centers reduces the quantity of milk supply to the milk collection centers. Similarly, studies conducted by Holloway, Charles, Nicholson and Delgado (2000); Gizachew (2005) and Charles,Delgado and Woldmichael (2008) found that there is negative relationship between distance to market and the probability of participation in formal milk market.

The coefficient of number of lactating cows was positive and significant at one percent level of probability. This implies that increase in number of lactating cows, *ceteris paribus* will lead to an increase in quantity of milk supply to the milk collection centers. The positive sign indicates that as the number of lactating cow increases, milk production per dairy household also increases which in turn increases the quantity of milk that will be supplied to the milk collection centers.

The coefficient of price of milk shows a positive relationship to the quantity of milk sold or supplied to the milk collection centers. Dairy farmers checked the prices of milk for their best benefit. The positive and significant relationship between the variables indicates that as the price of milk at milk collection centers increases, the quantity of milk sold at the milk collection centers also increases. The coefficient of the variable also confirms that a unit price increase in the milk price increase the quantity supply to the collection center by 1.158 liters. This result is consistent with Wolelaw (2005) findings.

Experience in dairy production was positively signed and significant at 5 percent level of probability. High experience resultantly manifests in increased knowledge of techniques involved in any enterprise. This is in agreement with a priori expectation. The positive sign implies that as experience in dairy production increases, the tendency for farmers being

integrated increases. As the number of years of experience the dairy farmers' increases, the tendency of commercialization also increases. This then increase the quantity of milk supply to the milk collection centers. This implies that for a unit increase in years' experience of dairy farmer's production the quantity of milk supplied to the milk collection centers increases by 0.175 units holding all other inputs constant.

Access to market information was significant and has a positive coefficient. The positive coefficient is in relationship with the general idea that market information significantly raised the tendency of market participation of households. (CIAT, 2004). Access to market information is expected to enhance the quantity of milk the farmers' will be willing to sell to the formal market.

Elasticity of productive resources and returns to scale

Table 4 presents the elasticity of coefficient and return to scale. The elasticity of production indicates a change in output relative to a unit change in input if other things are held constant.

Table 4: Elasticity of coefficient and return to scale

Inputs	**Elasticity**
Distance to the milk collection centers	-0.723
Number of lactating cow	0.152
Number of hard	1.521
Price of raw milk	0.143
Experience	0.111
Access to market information	0.121
Returns to scale	**1.324**

Source: ata analysis

The summation of coefficient of elasticity of 1.324 as shown in table 4, indicates an increasing returns to scale. With increasing returns to scale, it means that doubling all inputs will lead to more than double proportionate increase in output level. Implication of this is that if all inputs are increased by one unit, output will increase by 1.34 units. An increase in the input will bring about an increase in output.

Challenges faced by the dairy farmers

The challenges faced by the dairy farmers are presented in Table 5. The major challenges faced by the dairy farmers include inadequate credit, lack of suitable improve breed for milk production, diseases, lack of infrastructures, inadequate grazing land, unavailability of milking parlor, cost of production and inadequate water.

Table 5: Distribution of Challenges Faced by the Dairy Farmer (n= 238)

Challenges	Extremely serious	Very serious	Moderately serious	Mild	Not serious	WS	MS	SD
Inadequate credit	175(73.5)	25(10.)	20(8.4)	18(7.)	1(0.4)	1071	4.5	0.93
Lack of infrastructure	132(55.5)	62(26.)	21(8.8)	22(9.)	1(0.4)	1020	4.3	0.96
Inadequate grazing land	77 (32.4)	28(11.)	41(17.2)	50(21)	41(17)	762	3.2	1.51
Lack of suitable breeds	201(84.4)	29(12.)	5(2.1)	1(0.4)	2(0.8)	1140	4.9	0.57
Inadequate water	176(74)	29()	26(11)	6(2.5)	1(0.4)	1087	4.6	0.81
Distance to the MCCs and market	142(59.6)	14(6)	36(15)	36(15)	10(4.)	985	4.1	1.30
Unavailability of milking parlor	164(68.9)	55(23.)	12(5)	5(2.1)	2(0.8)	1087	4.6	0.76
Cost of production	188(79)	24(10)	21(8.8)	4(1.6)	1(0.4)	1112	4.7	0.76
Storage problem	101(42.4)	114(4)	12(5)	10(4.)	1(0.4)	1018	4.3	0.77
Diseases	75(31.5)	55(23.)	33(13.7)	45(19)	23(9.)	831	3.5	1.39

Note: figures in parenthesis s are Percentage; WS = Weighted score; MS = Mean score; SD = Standard deviation. Source: field survey

It is revealed that inadequate credit with a weight score of 1071 indicates that majority of the farmers lack credit facility. This could hinder them from procuring more high quantity breed cattle, supplementary feeds and artificial insemination for producing high quality cows with high lactating capacity. Another challenge faced by the dairy farmers in the study area was lack of improved breeds of cattle. This limited the production of milk to the poorly genetically quality of local breeds of the cattle, which in turn limit their milk yield. The local breeds have limited potential for optimum milk production.

Lack of infrastructure is another problem identified during investigation with a mean of 4.28. There is no adequate access road linking the producing community in the study area. There is also no electricity in most parts of the study area. Availability of milking parlor is another constraint faced by the famers in the study area. Non-availability of milking parlor and equipment affect the quality of milk produced by the farmers in the study area. Investigation during survey revealed that most of the farmers hand milk their animals by local milk maids.

The result agrees with the findings of Daniel (2010), who found out that majority of dairy farmers in Nigeria do not have access to milking parlor and milking is done by hand.

Diseases is identified as one of the constraints faced by the dairy farmers in the study area, with a weight score of 831.The occurrence of tsetse fly, Contagious Bovine Pleura Pneumonia (CBPP) and several tick-borne diseases like Babesiosis, Anaplasmosis are major problems to dairy cattle.

Inadequate water with a weight score of 1087 is another constraint faced by the respondents. Water is important for animals' survival and production. Availability of water is a major problem during dry season. Investigation reveals that most of the farmers move their animal from place to place in search of water. Water scarcity for cows can lead to serious weight loss and reduction in the quantity of milk produced. This finding is in line with Daniel (2010) who found out that dairy production among small and medium scale farmers in Nigeria are faced with inadequate water during dry season. Inadequate grazing land is also one of the constraints facing the dairy farmers. This has led to land and crop damage which has caused serious conflict between Fulani herdsmen and crop farmers.

Conclusion

Analysis revealed that distance to the milk collection centers negatively influenced milk supplied to milk collection center while the number of herd, price of milk, number of lactating cows, access to market information positively determined the quantity of milk supply to the milk collection centers. The problems that impede the increase in cow milk production and marketing in the study area were lack of improved breeds of cattle that are suitable for milk production, inadequate credit, cost of production and diseases. Others were lack of infrastructures, inadequate grazing land and inadequate water.

Recommendations

Based on the findings of this study, the following recommendations are suggested:

1. Increased practice of cross breeding as well as the use of artificial insemination should be encouraged among the local dairy farmers as this could help in increasing the number of lactating cows.

2. Formation of co-operative society should be encouraged among the farmers to enable them negotiate and obtain optimum price for their product when they sell at the milk collection center.
3. Modern production and processing techniques such as milking parlor/ centers, milking machines, cooling vans, exotic bulls for cross breeding should be made available to dairy farmers in the study area by Government and private sectors.

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