NIGERIAN DAIRY DEVELOPMENT PROGRAMME (NDDP)

Nutrition Assessment of Smallholder Dairy Farmers In Oyo and Kano States

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SAHEL Consulting
AGRICULTURE & NUTRITION LTD.

DISCLAIMER

The report has been prepared by Sahel Consulting Agriculture and Nutrition Limited (Sahel Consulting) with support from Dr Olutayo Adeyemi.

This report is based on findings from field research conducted by Food Basket Foundation International (FBFI) among smallholder dairy producing communities in Oyo and Kano states as part of the Nigerian Dairy Development Programme (NDDP).

The findings of this report are solely based on information provided by the respondents interviewed and the literature review. This report is for the exclusive use of NDDP.

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ACRONYMS

AEO	Agricultural Extension Officer
ANC	Antenatal care
BCC	Behaviour Change Communication
BMI	Body Mass Index
CHEW	Community Health Extension Worker
CL	Community leader
FAO	Food and Agriculture Organization of the United Nations
FBDGs	Food Based Dietary Guidelines
FCW	FrieslandCampina Wamco
FES	Food expenditure as a share of total expenditure
FGD	Focus Group Discussion
FIVIMS	Food Insecurity and Vulnerability Information and Mapping Systems
HCA	Heads of cattle associations or heads of milk sellers' cooperatives
HDDS	Household Dietary Diversity Score
HHS	Household Hunger Scale
IDI	In-depth Interview
IFPRI	International Food Policy Research Institute
KII	Key Informant Interview
L&Z	L&Z Integrated Farms Nigeria Ltd.
LGA	Local Government Area
MC	Milk collectors or milk men
MCC	Milk Collection Centre
MDD-W	Minimum Dietary Diversity Indicator for Women of Reproductive Age
MP	Milk processors (FCW and L&Z) staff
MUAC	Mid Upper Arm Circumference
NDDP	Nigerian Dairy Development Programme
NFP	Nutrition Focal Person
SADP	States Agricultural Development Programme
SPSS	Statistical Package for Social Sciences
UNICEF	United Nations Children's Fund
WASH	Water, Sanitation and Hygiene
WHO	World Health Organization

EXECUTIVE SUMMARY

Background and Objectives

The Nigerian Dairy Development Program (NDDP) is a processor-led program implemented by Sahel Consulting, in partnership with leading dairy processors; Friesland Campina WAMCO in Oyo State and L&Z Integrated Farms in Kano State, Nigeria. The program seeks to enhance the livelihoods of participating Fulani dairy farmers in both states by improving the productivity of their cattle and integrating them into the formal dairy value chain in Nigeria.

The program also seeks to improve women empowerment and the nutrition outcomes of the participating dairy communities.

In order to design effective women empowerment and nutrition interventions, it is critical to better understand the cultural beliefs, knowledge, attitudes, and practices of Fulani dairy producing households and how they influence social norms.

To that end, Sahel Consulting commissioned a nutrition study in the NDDP's focus states, which objectives were to:

1. Assess the nutrition situation of participating smallholder dairy households in Oyo and Kano States
2. Characterize the food systems and factors influencing their food choices
3. Determine potential entry points for improving their nutritional status.

Methods

Cross-sectional data was collected from 504 households in 21 communities in 9 LGAs of Oyo and Kano States. Data was collected from September to November 2017. The study targeted integrated households that supply milk to NDDP processors partners as well as non-integrated/identified households that produce milk but do not yet supply to NDDP processors. Data collection was guided using the conceptual framework of malnutrition, food insecurity and vulnerability information and mapping systems framework, and pathways through which agriculture can improve nutrition. Tools used in collecting data included a quantitative household survey, focus group discussions, interviews, transect walks, and market observations. Quantitative data was analyzed using descriptive statistics, chi-square and Spearman's rank correlation coefficient in Stata 12.0. The probability of decision error was set at 0.05. Qualitative data was translated and transcribed from Hausa/Yoruba to English and was analyzed using Atlas.ti version 7. The findings and recommendations from the study were presented at stakeholder meetings in Abuja, in Oyo State and in Kano State to raise awareness on gender and nutrition opportunities and challenges in the dairy sector, and to secure participants' buy in and support around proposed interventions. Attendees included representatives from the public, private and social sectors. Meetings were also conducted with respondents in both states and at the community level to validate the report's findings. The feedback provided by meetings' participants was used to further refine the report.

Results and Discussion

Nutrition situation: The underweight prevalence among women is 33.5% and 27% respectively in Oyo and Kano, reflecting a serious situation in both states[1] according to WHO classifications.

[1] According to the World Health Organization (WHO), an underweight or obesity prevalence of 5% – 9% among women denotes a warning situation requiring monitoring; one between 10% – 19% denotes a

Meanwhile, the overweight/obesity prevalence is 2.5% and 13% respectively in Oyo and Kano, indicating a poor situation[1] in Kano. Among children 6 to 59 months old, the prevalence of acute malnutrition is 4% and 19% in Oyo and Kano respectively, reflecting an acceptable situation in Oyo and a critical situation in Kano[2]. Assessed immediate, underlying, and basic determinants of malnutrition, which includes Minimum Dietary Diversity for Women of reproductive age (MDD-W), food expenditure as a share of total expenditure and access to care and health are inadequate.

More than 33% of the women in both states did not achieve MDD-W of 5 food groups out of 10, an indication of their poor diet quality and inadequate micronutrient intake. Given that the data for the study was collected during the harvest season in both states when food tends to be more bountiful, the current findings of MDD-W are possibly the best-case scenario for the study population. Results may be worse during the lean season.

The prevalence of food insecurity and hunger was significantly lower in Kano than in Oyo at the time of data collection; though key informants reported them to be higher in both states at other times in a year. For food insecurity, food expenditures are on average 30% of total expenditures in Oyo, while they are 24% of total expenditures in Kano ($p=0.0006$). Further, 14.2% of households in Oyo have a food expenditure as a share of total expenditure (FES) ≥50% compared to 4.8% of households in Kano ($p=0.001$). The prevalence of moderate/severe hunger is 10.1% in Oyo and 0.5% in Kano ($p<0.001$). There is no overlap in Kano and only 1% overlap in Oyo between households with FES≥50% and those experiencing hunger. This means that affected households either spend a high proportion of their disposable income on food or experience hunger, but do not experience both. 38% and 21% of households ($p<0.001$) respectively in Oyo and Kano, spent less than the minimum per capita cost of a nutritious diet in the 30 days preceding the study.

Access to care and health is higher in Kano than in Oyo. 47% of women in Oyo received zero antenatal care, while 53% of them had zero child delivery assistance for their last child. The corresponding figures in Kano were 12% and 14%. 34% of the households in Oyo are below the poverty line of US$1.25/day, while 55% of them are below the US$1.90/day poverty line. In Kano, 12% and 27% of households respectively are below these lines. Access to functional health facilities and community health extension services are 74% and 57% respectively in Oyo, and 94% and 100% respectively in Kano. The use of improved drinking water sources and improved sanitation are 36% and 9% respectively in Oyo, and 75% and 70% respectively in Kano.

Gender Dynamics: The NDDP gender study conducted in parallel to the nutrition study found clearly defined gender roles in the study communities. Women are heavily involved in decision-making around childcare and minor household expenditures including daily consumables. Many women, especially first wives also may have some input into decisions around crop production, livestock rearing, and major household expenditures, depending on the extent to which their husband consults them. Although women are heavily involved in decision-making around dairy, their roles are prominent in processing and marketing, while men, particularly in Oyo perform the bulk of roles related to animal husbandry, milking the cows and transporting milk to collection centres (for integrated households). Cattle are predominantly owned by men, while women tend to own and exercise more control over small animals like poultry, goats, sheep and rabbits. The differences between Oyo and Kano that were observed in the

poor situation; one between 20% – 39% denotes a serious situation, while one above 40% denotes a critical situation.

[2] According to WHO, acute malnutrition prevalence between 5% – 9% reflects a poor situation, while a prevalence ≥15% represents a critical situation.

nutrition study persisted in the gender study, with women in Kano having more access to productive resources (such as land and livestock) than women in Oyo. Also, similarly to what was observed in the nutrition study, the gender study found that women in Oyo are actively involved in providing money for household food. The milk money earned by women in Oyo may be used by the women to purchase food for the household, whereas in Kano, women use milk money for their personal needs and the men remained the primary provider and purchase of household food. In addition to limited decision-making ability, women also have heavy workloads. On another note, the gender study found that women lack improved equipment for milk production and formalized structures of support and are not adequately represented in existing cooperatives and associations.

Food system characteristics: Diverse foods are generally available to households all year-round, either from their own production or from markets. However, physical and financial access are constraints. Households in both states have to walk an average of 50 minutes to get to markets or incur the costs of another mode of transportation. Food prices vary throughout the year. Moreover, high levels of poverty and large family sizes were cited by respondents as challenges to purchasing and consuming adequate diets. Around 25% of households in both states reported prioritizing one or more household members when sharing food. In these households, the head of the household (husband) is typically prioritized.

Men play a key role in food purchases and consumption. In Oyo, 73% of men are the primary providers of food money compared to 22% of women. 66% of men are the primary purchaser of foodstuff and 38% of them are the primary influencers of meals prepared. Meanwhile, 30% of women are the primary purchasers of foodstuff and 60% of them are the primary influencers of the types of food prepared. Men play an even larger role in food decisions in Kano. 95% of men are the primary providers of food money compared to 5% of women. 76% of men are the primary purchasers of foodstuff and 58% of them are the primary influencers in the choices of food prepared. Meanwhile, 24% of women are the primary purchasers of foodstuff and 41% of them are the primary influencer of food prepared. The income that women allocate towards food is typically derived from milk and/or milk products sales.

When food consumption patterns in the three months preceding the study were compared with South African and US food-based dietary guidelines (FBDGs), merely 20% and 16% ($p=0.20$) of households in Oyo and Kano respectively appeared to have met the FBDGs. Nigerian FBDGs were not used for the study as they are vague and do not suggest a specific number of days in a week that any food group should be consumed. Cereals, non-leafy vegetables, and fats and oils are the food groups most reported to be consumed daily by households in both states. Fish/meat, eggs, and fruit are the food groups least consumed daily. Meat is reported to be consumed rarely or never by 15% and 12% of households in Oyo and Kano respectively, and eggs are consumed rarely or never by 25% and 17% of households respectively in Oyo and Kano. Food choices are mainly driven by food availability and affordability, migration, knowledge, tradition/culture, and infrastructure.

Nutrition entry points: The consumption of households' own production, market/prices, and the women's empowerment pathways appear to be the most important pathways for improving nutrition within the context of the study population. There is a direct relationship between the volume of milk produced and the volume consumed in each state. The reported median volume of milk produced by households in Oyo and Kano is 30 litres/day and 25 litres/day respectively, while the reported median volume consumed is 0.50 litres/person/day and 0.67 litres/person/day respectively in Oyo and Kano. The milk consumed includes all milk products, such as butterfat, cheese and not just fluid milk. The volume of milk produced is also

significantly associated with the volume sold. Integrated households sell a statistically higher proportion of their produced milk than non-integrated households. About 4% of integrated households reported selling 100% of the daily milk they produced.

The mean daily milk income reported by households is ₦632 (median ₦329) and ₦2027 (median ₦968) in Oyo and Kano respectively (p=0.0008). The difference is due to the fact that the unit price for milk is higher in Kano (₦170 - ₦220/litre) than in Oyo (₦90/litre). Income levels are however likely to have been underreported as seen in other studies in developing countries, since income is subject to recall and there are no objective verification methods e.g. income tax returns. Nevertheless, there is no significant difference in milk income between integrated and non-integrated households in either state, due to higher milk products' prices on the informal market compared to prices paid by the formal processors for raw milk. This however does not account for the costs incurred by households to transform the raw milk into milk products and to transport them to the market. In Oyo State, there is a significant association (p=0.002) between milk income tertiles and whether or not a woman met MDD-W. There is positive association between milk income and MDD-W in Oyo but not in Kano. This is a possible reflection of the greater ability of women in Oyo to buy food with income generated from milk.

FCW provided limited human nutrition training to women in Oyo. Women who had reported attending nutrition training in Oyo, but not Kano, were statistically more likely to meet MDD-W. In Oyo, 86% of women who reported receiving training met MDD-W compared with 64% of women who had not (p=0.048). Similarly, there was a significant relationship (p=0.04) between use of skilled antenatal care (indicating likelihood of higher exposure to nutrition education) during the last pregnancy and MDD-W in Oyo State, but not Kano. Again, this finding may reflect the greater influence women in Oyo have over food decisions since opportunities and ability to use nutrition education are important for translating knowledge into improved practices.

Table 0 below summarizes the prevalence and key determinants of malnutrition among studied households in Oyo and Kano.

Table 0: Prevalence of Malnutrition and Determinants of Malnutrition in Oyo and Kano States

Indicator	Oyo State (%)	Kano State (%)
Malnutrition Outcomes		
Underweight in women	33.5	27.0
Overweight/obesity in women	2.5	13.2
Acute malnutrition in children	4.4	19.0
Immediate Causes of Malnutrition		
Not achieving minimum dietary diversity in women	33.5	36.8
Underlying Causes of Malnutrition		
Households likely not meeting food based dietary guidelines	80.1	84.5
Food expenditure share in total expenditure ≥50%	14.2	4.8
Moderate/severe hunger	10.1	0.5
Zero antenatal care	47.0	11.9
Zero child delivery assistance	53.1	13.8
Basic Causes of Malnutrition		
Earn less than US$1.90/day	55.0	27.0
No access to functional health facilities	25.7	6.1
No access to community health extension services	43.3	0.5
Unimproved drinking water sources	64.5	24.9
Unimproved sanitation	91.4	30.1

Indicator	Oyo State (%)	Kano State (%)
Women as primary provider of food money	21.6	5.4
Women as primary purchasers of household food	30.2	24.4
Women as primary influencers of types of food prepared	60.5	41.3
No participation in nutrition training	89.2	95.4

Recommendations

The following recommendations build on the findings from the study, the interpretations of these findings using existing literature, insights from the gender study, and general principles for making agriculture nutrition-sensitive, to develop gender sensitive interventions that can improve nutrition outcomes in smallholder dairy households.

1. Provide Support around Food Production

Dairy households need to be supported to increase their food production and productivity, to diversify crops cultivated; and to provide adequate postharvest handling to improve year-round food access and affordability.

Relevant interventions include working with the states and local communities to improve dairy farmers' access to land ownership/rental for cultivation, providing training & extension services around good agronomic practices as well as increasing farmers' access to quality inputs in order to increase their yields.

In terms of food diversification, fresh green leafy vegetables, animal source foods and intercropping of cereals with legumes can be prioritized. Households can also be supported to shift from conventional to biofortified varieties of crops grown. Poultry production can also be prioritized to promote the consumption of eggs, since they are generally acceptable as nutritious but poorly consumed.

Finally, adequate postharvest handling is needed to support year-round food access and affordability as well as to encourage nutritious diets during migration. These can include increasing access to mechanical dryers by providing them to women cooperatives, providing training and practical demonstrations on optimal postharvest handling of different foods

Implementers: LGA Department of Agriculture, State Agriculture Development Programme (SADP), Development Partners

2. Livelihood and Productivity Improvement Support for Households

Various interventions should be implemented as part of broader women empowerment actions so that women are able to increase their income and use it to improve their households' nutrition systems. Cooperatives/associations should be formed to promote women's participation and leadership in the dairy sector and to support income generation interventions

In addition, interventions such as the provision of veterinary and extension services as well as the improvement of farmers' access to feed & fodder can help reduce cattle diseases and other cattle challenges, thereby increasing the value of the animals and their productivity and the income derived from them and their milk. These services can be provided for a fee through farmers' cooperatives and associations by state and/or private vets, extension officers and commercial fodder producers.

Dairy processors can work with farmers' cooperatives and associations to support women through grants or loans to gain access to adequate processing technologies, and equipment for increased efficiencies in milk processing and improved milk quality.
Smallholder dairy farmers' associations and cooperatives should be strengthened to enable them to more effectively negotiate mutually advantageous partnerships and prices with the dairy processors.
Finally, income diversification interventions can also be established through the cooperatives. These can include vocational training to teach women other trades, communal raising and sale of small livestock.

Implementers: LGA Department of Agriculture, SADP, Development Partners, Dairy processors

3. Water, Sanitation and Hygiene (WASH) Support

WASH support interventions are needed to improve human nutrition, cattle productivity and thus milk yields and income. They could include the construction of toilets and of improved water sources; the establishment of water resources management systems to ensure sufficient and safe water for human and animal needs; and community mobilization. In addition, behaviour change education and communication campaigns are needed and should be targeted at both men and women to drive actual change in improved hygiene practices and in the use of WASH facilities.

Implementers: Rural Water Supply and Sanitation Agency (RUWASSA), LGA WASH Units, Community WASH Committees, LGA Department of Agriculture, SADP, Development Partners, Civil Society Organizations, Dairy processors

4. Nutrition Education, Behaviour Change Communication (BCC), and Social Marketing

Nutrition education should be provided to communities and should target both men and women. It should be focused on enabling households to not only gain knowledge about the meaning of adequate nutrition, including dietary diversity, but also to gain the knowledge necessary to use nutrition information e.g. how to prepare meals incorporating different food groups. Interventions could include the integration of nutrition education into all platforms through which contact is made with dairy households e.g., extension officers, cooperatives, CHEW; the identification of barriers to adopting nutrition education and BCC; food demonstrations and skill-building sessions; and social marketing and mobilization. Appropriate and adequate provision of nutrition education, BCC and social marketing will first require sufficient capacity building for extension agents (e.g., from agriculture and health ministries) who would be training farmers. Such capacity can be built by harnessing existing nutrition training materials and tailoring them to the capacity needs of relevant staff.

Implementers: LGA Departments of Agriculture and Health, SADP, State Ministries of Health, Development Partners (including Food and Agriculture Organization of the United Nations and other Partners)

Conclusion

This study demonstrates how malnutrition is a considerable challenge among smallholder dairy producers in Oyo and Kano. There is a serious underweight prevalence among women in both states, and a critical prevalence of acute malnutrition among young children in Kano. The

overweight/obesity situation in Kano is also high and a cause for concern. Although Kano households have better access to resources for food than those in Oyo, health, and care, health service utilization, access to nutritious foods, and dietary intake is equally inadequate.

The findings also suggest that there are seasonal variations in food availability and access; and that even the insufficient access observed is likely to be a best-case scenario as the study was conducted during harvest, when food is more bountiful in both states.

In addition, the study showcases the important role that men play in food purchases and consumption, particularly in Kano. Women's control over food resources and involvement in food decisions seem to be very critical for improving nutrition since opportunities and ability to use nutrition education is important for translating knowledge into improved practices.

The own consumption, market/prices, and the women's empowerment pathways appear to be the most important pathways for improving nutrition within the context of the study population. The state agriculture and health departments, development partners and the dairy processors all have have a critical role to play in addressing challenges and constraints around nutrition and health. A mix of interventions are needed for improving nutrition outcomes among smallholder dairy households and should aim at increasing food production and income, providing nutrition education and WASH support.

1. INTRODUCTION

1.1 Background

1.1.1 Agriculture Context in Nigeria

The agriculture landscape in Nigeria is currently unable to deliver sufficient, affordable, nutritious, and sustainable food (IFPRI, 2015). Nigeria is, in fact, a food deficit country and a net food importer, with an annual food import growth rate of 11% (FMARD, 2017). Challenges faced by the agriculture sector in Nigeria include small production units (i.e. small farm sizes or herds for livestock farmers); the limited use of modern inputs and improved technologies/techniques; poor access to credit facilities; inadequate mechanization; seasonal food production as opposed to year-round production; poor farm-gate prices; and limited institutional and basic infrastructure, such as research and extension services (FMARD, 2016; FMARD, 2017). The consequences of the inadequate agriculture practices in Nigeria include high food prices influenced by volatile global market prices, food insecurity, and a high prevalence of malnutrition (FMARD, 2017).

Malnutrition primarily affects women and children and causes economic losses and a considerable burden of diseases. Malnutrition decreases the productivity and income of adults, while at the same time increasing healthcare costs and reducing savings and investments. Malnutrition thus creates and perpetuates poverty (Hoddinott et al. 2013; Shekar et al., 2014). In Nigeria, as a result of the challenges in the agriculture sector, households that depend on the sector for their livelihoods have some of the highest rates of malnutrition (UNAS, 2011).

1.1.2 Overview of the Dairy Sector

The domestic supply of milk in Nigeria is about 0.6 million tons whereas demand is 2.0 million tons, leaving a deficit of 1.4 million tons to be filled with imports (FMARD, 2016; PwC, 2017). In 2016, Nigeria imported about US$ 295 million worth of dairy products and dairy accounted for 6% of the total bill of food imports (PwC, 2017). The low domestic milk supply occurs as a result of low milk yields due to poor genetic composition of local cattle breed, poor feeding practices and archaic production practices (FMARD, 2016). Indeed, 80% of the challenges in the Nigerian dairy sector occur at the production stage (PwC, 2017). Nigeria has an estimated 20 million cattle, of which 2.3 million are used for dairy production and the remainder for meat production.

There are three main dairy production systems in Nigeria – the Settled Fulani Pastoral System, the Non-Settled Fulani Nomadic System, and the Large-Scale Dairy Farming System. The Settled and Non-Settled Fulani Pastoralists account for approximately 95% of the output in the dairy sector. The Settled Pastoralists cultivate crops in addition to cattle production and graze cattle on fallow ground or areas that have been recently harvested. Non-Settled Pastoralists move their cattle around and do not engage in farming. Both Settled and Non-Settled Pastoralists raise indigenous breeds of cattle (PwC, 2017) and are essentially smallholder dairy producers, with average herd sizes of 13 milking cows per producer in 2010 (Annatte & Shittu, 2011). Settled and Non-Settled Pastoralists are further affected by the same limiting factors for milk production (PwC, 2017). These factors include low milk yields of cattle breeds; poor animal nutrition; animal diseases; high input costs; and inadequate production techniques and technologies (Annatte et al., 2012; PwC, 2017). Both Settled and Non-settled pastoralists in Nigeria

have an average milk output of 0.8 litres/cow/day, compared to pastoralist global average of 6.6 litres/cow/day (PwC, 2017).

Milk processing and marketing among the Fulani Pastoralists is done almost exclusively by women, although men are often involved in milking cows (Land O'Lakes, 2007). Women also control the income from sales of milk. Milk processing and marketing challenges include inadequate access to appropriate and/or improved technologies; poor milk safety, hygiene and sanitation practices; lack of cold chain infrastructure; and inadequate market access (Land O'Lakes, 2007; Annatte et al., 2012; PwC, 2017). A key market access challenge for locally produced milk arises from a lack of competitiveness due to the ability of dairy processors to obtain imported milk at much lower prices. The Government of Nigeria traditionally adopted protectionist measures, such as high import tariffs, to protect local milk production (Nzeka, 2006). However, the implementation of the Economic Community of West African States (ECOWAS) Common External Tariff (CET) in 2016 led to the reduction of milk import tariffs from 10% to 5%. This measure, which was adopted by ECOWAS member countries in 2013, reduces the incentives for the local procurement and production of milk within the Nigerian dairy sector, thus hampering the development of the sector.

Dairy is an important source of macronutrients and several key micronutrients and constitutes an independent food group (Quann et al., 2015; FAO & FANTA, 2016). While there are no international recommendations for dairy and milk consumption (FAO, 2015a), and the Nigerian Dietary Guidelines does not quantify nationally recommended milk intake (FMOH & WHO, 2006), milk consumption in Nigeria is generally low. It is estimated that the average per capita consumption of milk in Nigeria is between 10 litres per year (PwC, 2017) and 20 litres per year (Annatte et al, 2012). The African average per capita milk consumption is 28 litres per year (PwC) and in some countries such as Kenya, consumption is up to 200 litres per year (Köster & de Wolf, 2012). The National Dietary Guidelines of the United States recommends consumption of about 265 litres of milk per person per year (Mullie et al., 2016).

In Nigeria, milk consumption is still relatively quite low even among the Fulani at around 50 litres per person per year, though it is higher than the national average (Annatte et al., 2012). The prevalence of malnutrition among the Fulani has also been reported to be high (Glew et al., 2003; Ekpo et al., 2008).

1.1.3 Role of the Nigerian Dairy Development Programme (NDDP)

Given the myriad of production, processing, and nutrition challenges among Fulani Pastoralists (smallholder dairy producers) and the consequent implications for the Nigerian dairy sector due to the contribution of their dairy output, there is a need for interventions targeted at pastoralists (Annatte et al., 2012). The Nigerian Dairy Development Programme (NDDP) is one such intervention. The NDDP is a processor-led dairy programme implemented by Sahel Consulting Agriculture and Nutrition Limited (Sahel) in partnership with leading dairy processors – Friesland Campina WAMCO (FCW) in Oyo State and L&Z Integrated Farms Nigeria Ltd. (L&Z) in Kano State. The aim of the NDDP is to strengthen the Dairy Transformation Agenda of the Federal Government of Nigeria by demonstrating proof-of-scale in Nigeria's processor-led initiatives for dairy development. The programme seeks to enhance the livelihoods of participating dairy farmers in Nigeria by improving the productivity of their cattle and integrating them into

the formal dairy value chain. The programme also includes a nutrition and a gender component geared towards improving nutrition outcomes and empowering women in smallholder farming communities.

1.2 Rationale of the Study

To understand the determinants of malnutrition among dairy farmers, and identify potential approaches for improving their nutritional status, a nutrition study was undertaken among smallholder dairy households in Oyo and Kano States. This nutrition study was conducted in parallel with a gender study within the context of the NDDP.

1.3 Study Objectives

The specific objectives of the study were to:

1. Assess the nutritional situation of NDDP participating smallholder dairy households in Oyo and Kano States
2. Characterize the food systems and identify factors that likely influence their food choices
3. Determine potential entry points for improving their nutritional status, with a focus on food systems entry points

2. METHODS

2.1 Study Design and Population

The study used a descriptive, cross-sectional design and targeted Kano and Oyo States, the intervention states for NDDP. In Kano State, 15 settlements across four communities were selected from 4 clusters – Kura, Dawakin Kudu, Gezawa, and Garun Mallam; while in Oyo State, 24 settlements across 17 communities were selected from 5 clusters – Saki, Alaga, Maya, Fasola, and Iseyin. The study included both integrated and non-integrated households from each community. Integrated households currently supply milk to processors involved in the NDDP, while non-integrated households are households in the community that have cows but do not yet supply milk to these processors.

2.2 Theoretical Frameworks

Data collection and analyses for the study objectives were guided using existing frameworks.

2.2.1 Objective 1

To assess the nutritional situation of smallholder dairy households in Oyo and Kano States, the conceptual framework of malnutrition (UNICEF, 1990) was used to guide data collection and analyses. Data was collected at the level of the manifestation i.e. nutritional status outcome, as well as at the immediate, underlying and basic levels of causation, using the domains specified in the framework (Figure 1). The indicators to assess each domain were identified from the extended UNICEF model developed by Engle et al. (1997); the consolidated approach to reporting indicators of food security (WFP, 2015); and the compendium of indicators for nutrition-sensitive agriculture (Herforth et al., 2016). The nutrition manifestation was assessed using women's body mass index (BMI) and acute malnutrition prevalence in children measured using mid-upper arm circumference (MUAC). At the immediate level of malnutrition determinants, diet quality was measured using women's minimum dietary diversity (MDD-W) indicator. At the underlying level, food security was measured using food expenditure as a share of total expenditure and household hunger scale. Care was measured by assessing the prevalence of zero antenatal care and zero assistance during child delivery. Health services and environment was measured using the prevalence of skilled antenatal care, skilled delivery assistance, child delivery in a health facility, and child immunization. At the basic level, resources and control for food security were assessed using household income, land ownership, number of cattle owned, access to veterinary services, and access to agricultural extension services. Resources for care were assessed using women's access to nutrition knowledge, women's workload and time availability, and women's ability to make decisions. Health resources were measured using the prevalence of improved drinking water, improved sanitation, access to functional health facility, and access to community health extension services. Table 1 highlights the different indicators used to assess the domains and the definitions used to categorize the nutrition situation.

2.2.2 Objective 2

To characterize the food systems and identify factors that likely influence their food choices, constructs and domains specified by the Food Insecurity and Vulnerability

Information and Mapping Systems (FIVIMS) framework (FAO, 2002) and the Value Chains and Nutrition framework by Gelli et al. (2015) were used. Food availability was measured by assessing food production and market provisioning. Food access was measured by examining transport and market infrastructure, physical access to markets, and household sources of food. Stability was measured by assessing seasonality of food availability, access and consumption. Habitual diet quality was examined by assessing consumption patterns of various food groups. Under-consumed and over-consumed foods, gender roles around food purchase and preparation, intra-household food distribution, cultural beliefs and practices around food were further assessed. The major drivers of food consumption choices were subsequently examined.

Figure 1: Conceptual Framework of Malnutrition Highlighting Potential Entry Points for Agriculture to Improve Nutrition

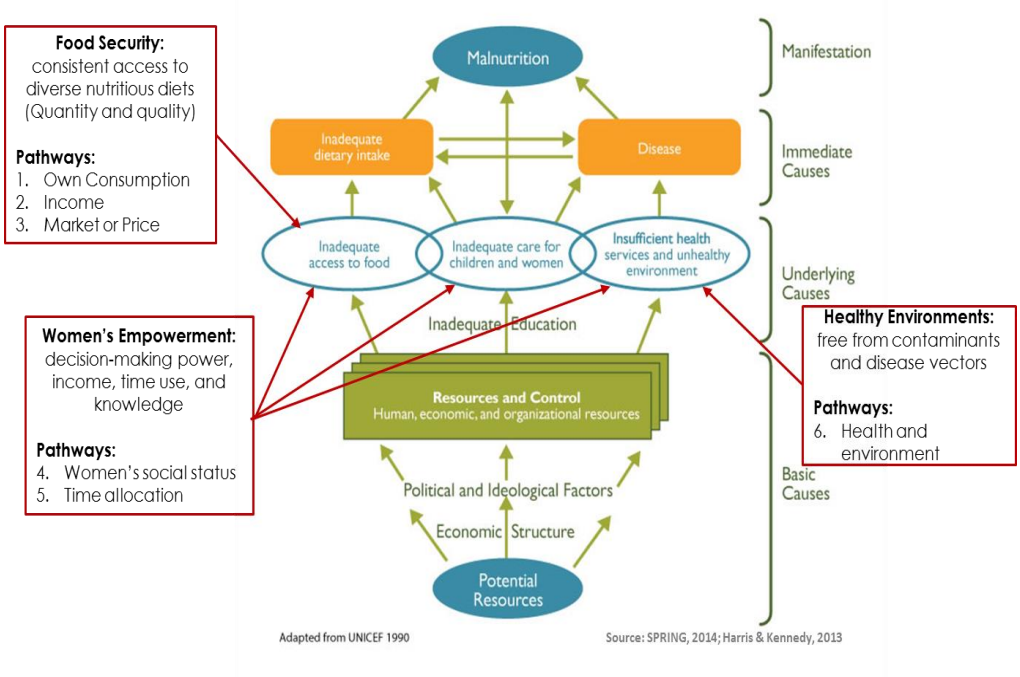


Table 1: Indicators and Definitions used to Assess Nutrition Situation

Domain	Indicator	Definitions and References to Indicator Guide
Manifestation	BMI in women of reproductive age (15 – 49 years old)	Underweight = BMI<18.5 kg/m^2 Normal weight = BMI 18.5 – 24.9 kg/m^2 Overweight/Obese = BMI ≥25.0 kg/m^2 (WHO, 2010)
	MUAC in children 6 – 59 months old	Global Acute Malnutrition (GAM) = MUAC <12.5 cm Moderate Acute Malnutrition = MUAC <12.5 cm but ≥11.5 cm Severe Acute Malnutrition = MUAC <11.5 cm (WHO& UNICEF, 2009)
Immediate determinants	Minimum Dietary Diversity Women (MDD-W) in women of reproductive age	Woman's dietary diversity in 24 hours preceding study < 5 food groups out of 10 food groups = poor diet quality and likely inadequate micronutrient intake (FAO & FANTA, 2016)
Underlying determinants	Food expenditure as a share of total expenditure (FES)	FES ≥50% = food insecurity (WFP, 2015)
	Inability to procure nutritious diet	Percent of households where per capita daily food expenditure was less than minimum cost of a nutritious diet. Minimum per capita daily cost of nutritious diet was set at 2010 costs of <US$0.31 derived from Busquet (2010) using the then Central Bank of Nigeria (CBN) exchange rates

Domain	Indicator	Definitions and References to Indicator Guide
	Household Hunger Scale (HHS)	HHS between 2 and 6 = moderate or severe hunger (Ballard et al., 2011)
	Prevalence of zero antenatal care	Prevalence of women who did not receive antenatal care from any source during their last pregnancy
	Prevalence of zero assistance during child delivery	Prevalence of women who were assisted by no one during the delivery of their last child
	Prevalence of skilled antenatal care (ANC)	Prevalence of women who received ANC from a doctor, midwife, or nurse (NPC & ICF International, 2014)
	Prevalence of skilled delivery assistance	Prevalence of women who were attended to by a doctor, midwife, or nurse during the delivery of their last child (NPC & ICF International, 2014)
	Prevalence of child delivery in a health facility	Prevalence of women who delivered their last child in a public or private health centre or hospital
	Prevalence of child immunization	Prevalence of eligible children who had ever received any immunization, including immunization given through campaigns
Basic determinants	Household income	Reported income and consumption/expenditure (NBS, 2012) 1. Reported income: Household income per person per day = total household income divided by household size, divided by 365 days. 2. Consumption: Household income per person per day = total household monthly expenditure divided by household size, divided by 30 days. Conversion to US$ was done using CBN exchange rate of ₦305=1US$. The prevalence of poverty was estimated by comparing consumption data to two poverty lines: US$1.25/day (UN, 2015) and US$1.90/day (Cruz et al., 2015).
	Land ownership	Percent of households who own the land they use for farming
	Access to veterinary services	Percent of households who took cattle to veterinary doctor or were visited by a veterinary doctor
	Access to agricultural extension services	Percent of households visited by an agriculture extension agent in 12 months preceding survey
	Women's access to nutrition knowledge	Percent of women who reported receiving nutrition training
	Prevalence of improved drinking water	Percent of households that obtain drinking water from piped water/tap, borehole, covered dug well, or covered rainwater (WHO & UNICEF, 2013)
	Prevalence of improved sanitation	Percent of households that use flush toilet or pit latrine with cover (WHO & UNICEF, 2013)
	Access to functional health facility	Percent of households that reported having access to a functional health facility
	Access to community health extension services	Percent of households visited by community health extension worker (CHEW) in 12 months preceding survey

2.2.3 Objective 3

Determining potential entry points for improving nutritional status was achieved by testing hypotheses around the six acknowledged pathways through which agriculture can improve nutrition (Ruel et al., 2013). Empirically, hypotheses examined the three pathways in which agriculture's impact on nutrition are mediated through food security, as well as the women's status pathway (Figure 1). The hypotheses also assessed the potential effect of a common mediator, nutrition knowledge, and examined whether improved diet quality was likely to enhance nutritional status among the population.

Table 2 highlights the pathways assessed and the hypotheses tested, the hypotheses tested for the common mediators, and the indicators used for hypotheses testing.

Table 2: Summary of Pathways Empirically Assessed and Corresponding Hypothesis

Pathway to Impact	Hypothesis Examined
A. Own consumption pathway	**H1: There is a direct relationship between increased milk yields and the volume of milk that is consumed by dairy households.** Milk yields were measured using reported volume of milk harvested by the household each day. Milk consumption was measured using household per capita daily milk consumption, which was obtained by dividing reported volume of milk consumed in the household by the household size.
B. Income pathway	**H2: Increased household income is associated with greater diet quality in dairy households.** Household income was measured using reported income as well as consumption as a measure of income. Diet quality was measured using MDD-W score.
C. Market/prices pathway	**H3: There is a direct relationship between increased milk yields and the volume of milk that is sold to processors.** Milk yields and volume of milk sold were measured using corresponding volumes households reported harvesting and selling daily.
D. Women's status pathway	**H4: Selling milk to processors will increase women's income from milk.** Statistical differences in milk income between integrated and non-integrated households were examined. Household's reported annual income from milk sales was divided by 365 to estimate daily income from milk
	H5: Women's decision-making power is associated with their diet quality and nutritional status. Women's decision-making power was measured using four indicators: daily income from milk; whether or not they were the primary provider of money used in purchasing food; whether or not they were the primary purchaser of food for the household; and whether or not they were the primary influencer on the type of food prepared in the household. Diet quality was measured using MDD-W score; nutritional status was measured by BMI.
E. Shared mediators	**H6: Empowering women with nutrition information is linked with increased diet quality.** Receipt of nutrition information was measured using two indicators: self-reported receipt of nutrition training as well as the use of skilled ANC during last pregnancy (based on assumption that nutrition education is provided during skilled ANC). Diet quality was measured using MDD-W scores.
	H7: There is a significant relationship between women's diet quality and nutritional status. Diet quality was measured using MDD-W score; nutritional status was measured by BMI.

2.3 Data collection tools and procedures

2.3.1 Household Level

Data about the nutrition situation and food systems was collected at the individual and household level using a quantitative, semi-structured, interviewer administered questionnaire. The questionnaire also collected information necessary for hypotheses testing. The questionnaire included questions about socio-demographic characteristics; frequency of consumption of various foods over the three months preceding the survey; nutrition training and knowledge; nutrition attitudes; milk production, consumption and

marketing; food production; and questions related to all the indicators specified in Table 1. A section of the questionnaire collected 24-hour dietary recall for women in the household.

2.3.2 *Community Level*

Data about the food system, food economy and food choices were collected at the community level using qualitative methods which included focus group discussions (FGDs), key informant interviews, in-depth interviews, community transect walks, and market observations. At least two FGDs, one with men and one with women, were conducted in each study cluster. The FGDs collected nutrition-related community information about on culture, knowledge, attitudes, practices, religious beliefs, food taboos, availability, accessibility and affordability, and consumption. Key informant interviews were conducted with five types of respondents: heads of cattle associations or heads of milk sellers' cooperatives, or their representative (HCA); agricultural extension officers (AEO); nutrition focal persons (NFP); milk processors (FCW and L&Z) staff (MP); and milk collectors or milkmen (MC) who serve as intermediaries between the smallholder dairy producers and the milk processing companies. In-depth interviews were conducted with heads/members of cattle associations and community leaders (CL). Community transect walks identified water sources, infrastructure, and other physical community attributes that may influence the food system and/or nutrition of the smallholder dairy producers. Market observations were conducted in commodity markets and dairy markets to identify available commodities, the distance, hence accessibility of the markets, and the price/affordability of the available commodities. Table 3 summarizes the sample sizes achieved for each of the data collection tools per state. For the household questionnaire, sample sizes per cluster ranged from 21 to 108 in Oyo, and from 23 to 83 in Kano.

Table 3: Summary of Data Collection Tools and Sample Sizes/Number of Replications

Data Collection Tool	Type of Respondent	Oyo State (N)	Kano State (N)
Household questionnaire	Integrated households	252	106
	Non-integrated households	45	101
	Women in households	270	195
	Children in households	203	141
Focus Group Discussions	Men	5	4
	Women	6	4
Key Informant Interviews	Heads of cattle associations or milk sellers' cooperatives	1	6
	Agricultural Officers	3	3
	Nutrition/community health focal persons	3	2
	Milk processor staff	4	4
	Milk collectors/men	4	3
In-depth interviews	Cattle association	1	3
	Community leaders	5	4
Transect walks		11	13
Market observations	Commodity market	4	3
	Dairy market	2	3

All data collection tools were pre-tested, and modified as necessary, prior to data collection. The pre-test was conducted in a local government area (LGA) in Oyo State that was not included in the study but with characteristics expected to be similar to those of the study population. Data was collected by trained research assistants for

Kano and Oyo State who spoke Hausa/Fulani and Yoruba respectively. In Kano State, one team with 5 research assistants and 1 team lead collected the data; while in Oyo State data was collected by two teams each made up of 6 research assistants (3 male and 3 female), 1 data entry personnel and a team lead. Pre-test of the data collection tools occurred in August 2017. Data collection took place from late September to early October 2017 in Oyo State and in November 2017 in Kano State. Study communities were mobilized through a pre-entry dialogue with community and association/cooperative gatekeepers in July 2017. During the data collection process, community leaders were visited to obtain formal permission for the study and access to the study households.

2.4 Sampling

Representative quantitative data was collected among smallholder dairy households in Kano and Oyo States, with an emphasis on households currently participating in the NDDP. A multistage sampling technique was used to select study households. At the first stage, LGAs and clusters were purposively selected based on partnering dairy processors' areas of focus. Subsequently, sample sizes for each cluster were calculated using proportionate allocation such that clusters with larger populations of integrated households had larger sample sizes. Integrated households within the clusters were then listed and study households were selected using simple random selection. Non-integrated households were also selected. All selected households who were available and willing to participate were included in the study. Within households, male respondents were selected if they were the household head and female respondents had to be a wife of the household head to be eligible. Preference was given to wives who had children under five, when available.

2.5 Data analysis and reporting

Quantitative data was entered in SPSS version 20 using a pre-coded template to minimize errors and was subsequently cleaned. Women's 24-hour dietary recall data was coded according to the consumption of the MDD-W food groups. Data was analysed at the state level in Stata 12.0. Descriptive statistics were used to summarize the data. Percentages were generally reported for categorical variables and means were reported for continuous variables with minimal outliers. Where there appeared to be outliers, median values were reported. The presence of outliers was detected using scatterplots. Tests for statistical differences were done using chi-square models for categorical variables and t-tests to compare means. Hypotheses were also tested using chi-square models when variables were categorical. Hypotheses tests between continuous variables were conducted using Pearson's correlation coefficient or Spearman's rank correlation coefficient, depending on which assumptions of linearity, normality, and no outliers were met. Where the assumptions for neither Pearson's nor Spearman's coefficient were met, the variables were recoded into categorical variables and chi-square was used to test associations. The probability of decision error, a, was set at 0.05.

Tests and statistics using BMI and MDD-W included only women of reproductive ages (15 – 49 years old), and thus excluded women younger than 15 or older than 49 years old (NPC & ICF International, 2014; FAO & FANTA, 2016). Statistics including BMI also excluded pregnant women. MDD-W data and data collected about frequency of

consumption of various foods were collapsed into food groups and compared with the United States (US) and South African food-based dietary guidelines (Vorster et al., 2013; HHS & USDA, 2015). The South African and US food-based dietary guidelines (FBDGs) were used because Nigerian FBDGs were worded vaguely and did not suggest a specific number of days in a week that any food group be consumed. The US and South African FBDGs recommend that each of 5 food groups – cereals/tubers; legumes; vegetables/fruits; meat/fish/eggs; dairy – be consumed daily.

Qualitative data was transcribed and translated from Hausa/Yoruba to English by competent third parties to minimize bias. Qualitative data analysis software, Atlas.ti version 7, was then used to highlight similar patterns of responses and major themes and sub-themes were created. Repeated and/or similar words and phrases that denote the same meaning or idea were grouped together as major themes. Within each major theme, recurrent words and phrases that refer to specific aspects of the theme were coded as sub-themes. This coding was done in relation to the specific objectives and domains/constructs under the assessment. Results were then added to the relevant portions of the draft report.

The findings and recommendations from the study were presented at stakeholder meetings in Abuja, in Oyo State (Ibadan, Fasola and Iseyin) and in Kano State (Kano GRA, Dawankin Kudu and Gezawa). The objectives of the meetings were to share findings from the study, raise awareness on gender and nutrition opportunities and challenges in the dairy sector, and to secure participants' buy in and support around proposed interventions geared towards improving gender empowerment and nutrition outcomes among smallholder dairy households in Nigeria. Attendees included representatives from the public, private and social sectors. Meetings were also conducted with the respondents at the community level in both states to validate the report's findings. The feedback provided by the meetings' participants was used to further refine the report.

2.6 Challenges

Challenges experienced during the data collection include:

Outdated household counts

Some household information received from the Sahel baseline study were no longer relevant as they had migrated. This mainly affected non-integrated households, which had to be replaced in the sample.

Length of questionnaire

The length of the questionnaire made interviews time consuming. Each questionnaire lasted about two and half hours per household resulting in respondent fatigue. Due to this, the nutrition and gender questionnaires were not administered at the same time in each community.

Difficulties with communal entry and unwelcoming villagers

Due to previous experiences with researchers and absence of follow up intervention from other organizations, some community members were reluctant to provide information.

Language barriers

There were language barriers. The assumption was that respondents from the Fulani ethnic group will speak Hausa and/or Yoruba. However, in few locations in Oyo, the respondents did not speak Hausa or Yoruba, but Fulfulde. The research assistant had to get an interpreter who understood Fulfulde and Hausa to help bridge the communication gap

Logistics, transportation and wear out

Rainfall, poor road conditions and distance between the communities in Oyo State limited access to the communities. In some cases, this resulted in late arrival to the study location and made it challenging to meet with the households' heads, who leave for work as early as 6 a.m.

Poor communication network

This affected co-ordination amongst research assistants, particularly in remote villages.

3. FINDINGS

The findings of the study are presented according to each objective, after a description of the socio-demographic characteristics of surveyed households.

3.1 Socio-Demographic Characteristics of Smallholder Dairy Producers

The households included in the study are primarily integrated households, especially in Oyo State where 84% of the study households currently supply milk to FCW. The majority of women respondents in the study are first wives. In both states, more than 60% of women respondents are in the 20 to 39 years age bracket. The women's ages ranged from 16 to 100 years in Oyo State, with a mean of 33 years; while in Kano, ages ranged from 15 to 80 years, with a mean of 31 years. Nearly all women are married, Muslims, and Fulani. 52% of households in Oyo and 33% of those in Kano are currently polygamous. 80% of women and 60% of those in Kano have received no formal education. Among educated women in both states, Arabic schooling is the most common form of education. Nearly all women in Oyo and 85% of those in Kano are not able to read or write at all in English. The patterns are similar regarding the education of household heads, though they tend to be more educated than their wives. The prevalence of no formal education among household heads was 60% and 36% in Oyo and Kano States respectively. Sale of milk and milk products is the predominant occupation among the women, whereas the household heads reported cattle rearing as their primary occupation. Households are generally large in both states. Household size in Oyo is 10 persons on the average, with a minimum of 2 persons and a maximum of 59 persons (median, 9 persons). In Kano, household size is a mean of 9 persons with a minimum of 1 person and a maximum of 28 persons (median, 8 persons).

Table 4: Background Characteristics of Smallholder Dairy Producers in Kano and Oyo States

Socio-demographic Characteristics		Oyo State		Kano State	
		N	%	N	%
Supply of milk to FCW or L&Z	Integrated household	250	84.2	106	51.2
	Non-integrated household	47	15.8	101	48.8
Type of family	Monogamy	143	48.2	135	66.8
	Polygamy	154	51.8	67	33.2
Age (years)	15 – 19	14	5.2	20	10.5
	20 – 29	106	39.6	75	39.3
	30 – 39	75	28.0	47	24.6
	40 – 49	45	16.8	28	14.7
	≥50	28	10.4	21	11.0
Marital Status	Married	288	97.0	192	96.0
	Divorced	2	0.7	3	1.5
	Widowed	7	2.4	5	2.5
Religious affiliation	Christianity	0	0.0	1	0.5
	Islam	296	99.7	204	99.5
	Others	1	0.3	0	0.0
Ethnicity	Hausa	1	0.3	0	0.0

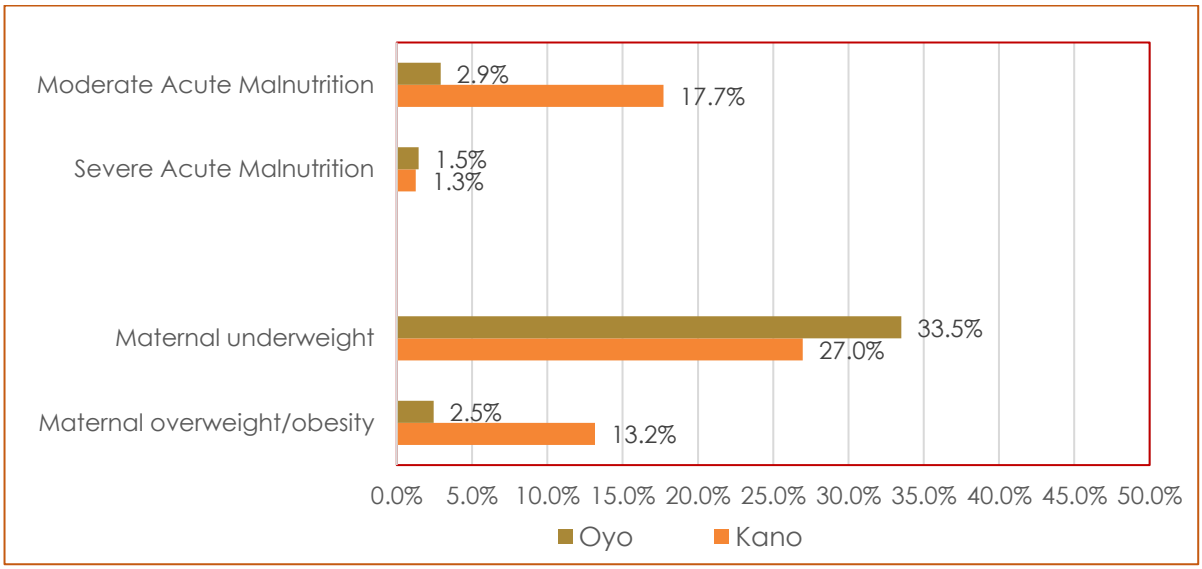
Socio-demographic Characteristics		Oyo State		Kano State	
		N	%	N	%
	Fulani	244	82.2	198	97.5
	Yoruba	6	2.0	5	2.5
	Bororo	46	15.5	0	0.0
Women's education	No formal	237	79.8	120	59.7
	Primary	10	3.4	16	8.0
	Secondary	2	0.7	3	1.5
	Tertiary	2	0.7	4	2.0
	Arabic school	45	15.1	58	28.9
	Others	1	0.3	0	0.0
Household head education	No formal	177	59.6	72	35.8
	Primary	11	3.7	21	10.4
	Secondary	7	2.4	8	4.0
	Tertiary	4	1.3	4	2.0
	Arabic school	97	32.7	95	47.3
	Others	1	0.3	1	0.5
Women's literacy in English	Read easily	2	0.7	0	0.0
	Read with difficulty	9	3.2	22	11.6
	Do not read	271	95.1	161	85.2
	Read and write	3	1.0	6	3.2
Women's primary occupation	Farming	6	2.1	0	0.0
	Trading	24	8.5	2	1.0
	Rearing of Cattle	10	3.5	1	0.5
	Sale of milk & milk products	243	85.9	188	98.4
Household head primary occupation	Farming	5	1.7	2	2.4
	Trading	3	1.0	0	0.0
	Rearing of Cattle	275	95.5	197	96.6
	Sale of milk & milk products	2	0.7	1	0.5
	Islamic clerics	3	1.0	1	0.5
Women's physiological status	Non-pregnant, 15 – 49 years old	235	79.1	153	76.9
	Pregnant	19	6.4	9	4.5
	Non-pregnant, ≥50 years old	43	14.5	37	18.6
Position as wife	First wife	221	74.4	175	86.2
	Second wife	58	19.5	24	11.8
	Third wife	1	3.7	4	2.0
	Fourth wife	1	0.3	0	0.0
	Other position	6	2.0	0	0.0
Household size (persons)	1-5	77	26.1	56	27.4
	6-10	102	34.6	99	48.5
	11-15	72	24.4	32	15.7
	More than 15	44	14.9	17	8.3

3.2 Nutritional Situation of Smallholder Dairy Farmers' Households in Oyo and Kano States

3.2.1 *Manifestation/Outcome*

Among children 6 to 59 months old, the mean MUAC is 14.8 cm and 13.5 cm in Oyo and Kano respectively. The prevalence of global acute malnutrition (GAM) is 3% and 18% in the two states respectively, with severe acute malnutrition (SAM) prevalence of 1.5% and 1.3% respectively (Figure 2). The average BMI for women of reproductive age is 19.6 kg/m^2 and 21.1 kg/m^2 in Oyo and Kano respectively. The underweight prevalence in women is 33.5% and 27% respectively in Oyo and Kano, while the overweight/obesity prevalence is 2.5% and 13% respectively (Figure 2). Just 64% and 60% of women 15 to 49 years old in Oyo and Kano respectively have normal weight. The differences in mean BMI and mean MUAC between the two states is statistically significant. Women in Kano generally have higher BMI than women in Oyo, but children in Oyo have higher MUAC than children in Kano.

Figure 2: Prevalence of Malnutrition in Women 15 - 49 Years Old and Children 6 - 59 Months Old in Smallholder Dairy Producing Households



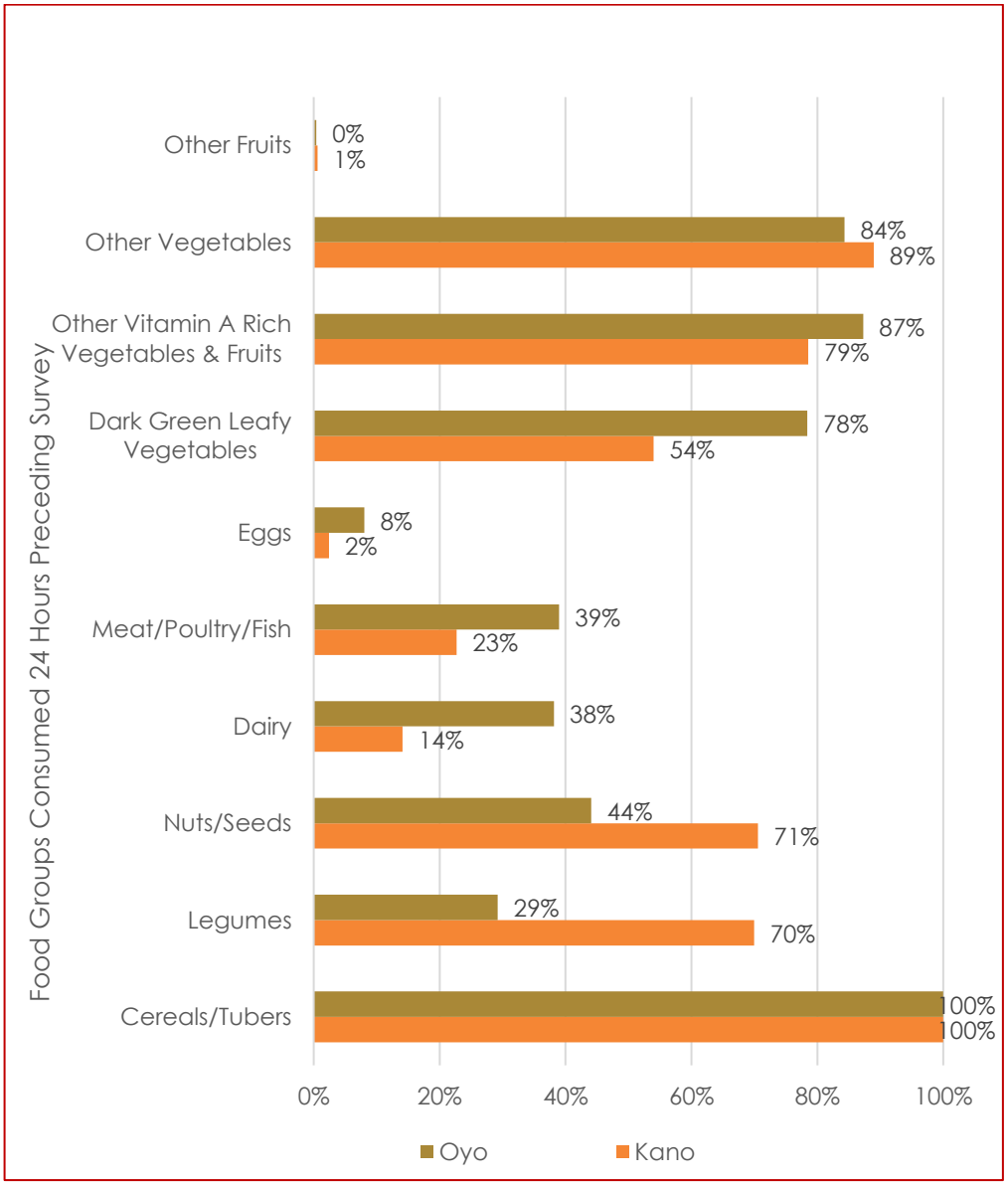
3.2.2 *Immediate Determinants*

The average minimum dietary diversity women (MDD-W) score is 5 food groups in both Oyo and Kano, with a range of 2 food groups to 9 food groups in both states. Figure 3 highlights the distribution of the score in both states. In Oyo and Kano respectively, 33.5% and 36.8% of the surveyed women 15 – 49 years old do not meet the MDD-W of 5 food groups. Diets appeared to be quite monotonous, with many women eating the same foods several times a day. The range of foods consumed across the women is also quite limited and is similar in both states. Women who met the MDD-W (66.5% and 63.2% in Oyo and Kano respectively) generally consume a starchy meal with a dark green leafy vegetable cooked with red bell peppers (other vitamin A rich vegetable), tomatoes (other vegetable) and locust bean seeds. Women who eat fish or meat with at least one of their meals, and/or drink milk or another dairy product during the day, and/or eat a bean dish for one or more meals, achieved MDD-W scores of 6 or more. Consumption of eggs is very low, and consumption of fruits is virtually non-existent in both states (Figure 4). Women who have MDD-W scores of 2 generally eat their starchy

meal with dark green leafy vegetables or okro cooked with just chilli powder, fat/oil and seasoning. Some women with low scores eat basically rice and beans cooked with chilli powder, oil and seasoning. Fats and oils, seasonings and condiments (such as chilli powder) do not count in the computation of the MDD-W (Figure 4). It is important to mention that the most frequently consumed dark green leafy vegetable is baobab leaves (*kuka*) which is consumed in its dry form and ground into powder. Dried okro is also consumed by many women. Okro, onions, tomatoes, and fresh chilli peppers are the most common "other vegetables" eaten while red bell peppers and pumpkin are the "other vitamin A rich vegetables" eaten. Consumption of animal source foods (dairy, eggs, meat/poultry/fish) is significantly higher ($p<0.001$) in Oyo (62.3%) than in Kano (34.4%). Consumption of both legumes and nuts/seeds is however significantly higher in Kano than in Oyo.

Figure 3: Distribution of Minimum Dietary Diversity for Women (MDD-W) Scores in Smallholder Dairy Producing Households in Oyo and Kano

Figure 4: Prevalence of Surveyed Women Who Consumed each of the Ten MDD-W Foods Groups in Oyo and Kano



3.2.3 *Underlying Determinants*

The prevalence of food insecurity and hunger is significantly lower in Kano than Oyo. For food insecurity, food expenditures are on the average 30% of total expenditures in Oyo, while they are 24% of total expenditures in Kano (p=0.0006). Further, 14.2% of households in Oyo have a food expenditure as a share of total expenditure (FES) ≥50% compared to 4.8% of households in Kano (p=0.001) and are considered food insecure. The prevalence of moderate/severe hunger is 10.1% in Oyo and 0.5% in Kano (p<0.001). There is no overlap between households with FES≥50% or food insecure households and those experiencing hunger in Kano; there is only a 1% overlap between the two types of households in Oyo. Furthermore, the estimated per capita daily food expenditure is less than the minimum per capita daily cost of a nutritious diet for a meaningful percent of households in both states. In Oyo and Kano, 38% and 21% of households respectively (p<0.001) spent less than the minimum per capita cost of a nutritious diet in the 30 days preceding the study. The minimum per capita daily cost of nutritious diet was set at

<US$0.31 derived from Busquet (2010)[3]. Mean per capita daily food expenditure in Oyo and Kano was US$0.63 and US$0.99 in Oyo and Kano respectively (p=0.0002).

For care, in Oyo, 47% of women received no antenatal care for the pregnancy of their last child, while 22% of women indicated receiving skilled antenatal care (from a doctor, nurse or auxiliary nurse). Moreover, 53% of women in Oyo had no one to assist them during the delivery of the child, while 14% of them noted receiving skilled child delivery assistance. In Kano, the prevalence of zero vs. skilled antenatal care is 12% and 29% respectively. Similarly, the prevalence of zero vs. skilled assistance during delivery in Kano is 14% and 30% respectively. 11.4% and 35.7% of women in Oyo and Kano respectively had given birth to their last child in a health facility (public or private) rather than at home. Furthermore, the prevalence of children who had received any immunizations was 70.7% and 98.5% in Oyo and Kano respectively. The differences between Oyo and Kano for all the care and health indices were significant at p<0.001.

Table 5: Type of Antenatal Care and Child Delivery Assistance Received in Oyo and Kano

	Antenatal Care (%)		Child Delivery Assistance (%)	
	Oyo	Kano	Oyo	Kano
None	47.0	11.9	53.1	13.8
Doctor	16.5	6.5	7.8	3.2
CHEW	21.4	48.1	1.1	8.5
Nurse	3.9	21.6	4.8	23.4
Traditional birth attendant	8.8	8.7	15.9	24.5
Auxiliary nurse	1.4	0.5	1.9	3.2
Relative/Other	1.1	2.7	15.5	23.4

Though the study did not collect quantitative data about dietary intake among children under 5 years old, information about infant and young child feeding practices was provided during focus group discussion and key informant interviews. It appeared that child feeding practices are inadequate. While some women reported that children less than 6 months old are fed with breast milk and then regular foods are introduced from 6 months, it seems that other women feed foods other than breast milk to children in the first 6 months. For women who reported feeding breast milk, it was not clear whether water is given in addition to breast milk in the first 6 months. The respondents stated that:

"We feed our children between 6 months to 1 year or 2 years with pap, milk, breast milk, we feed them with beans. Then from age 2 till 5, we wash their hands and allow them to feed themselves" (FGD 19, women, Kano)

"We give them kunu, pap, fura, cow milk, swallow made from maize (tuwo). The food we eat is what we give them" (FGD 15, women, Kano)

"We give them whatever we eat" (FGD 4, women, Oyo)

[3] https://hea-sahel.org/wp-content/uploads/2018/02/NG-cost-of-diet-assessment-katsina-nigeria-november-20106572986.pdf

"As you can see me standing, what I want to do for my child is that I will buy soya beans, buy fish, buy millet and blend together so my child can drink." (FGD 6, women, Oyo)

"Nunude (cow produce), and herbs, custard, noodles, Hot pap and sugar, tea" (FGD 11, women, Oyo)

"Although some among us don't feed them with pap when they are below 6 months old what we do is that the cheese we sell we ensure we cook it properly and after cooking we let it cool then add sugar before feeding them." (FGD 9, women, Oyo)

"From age one under, its breast milk but from one upwards they eat whatever we give especially rice, tuwo and cow milk" (IDI3, CL, Oyo)

3.2.4 Basic Determinants

Resources for food security, health, and care are generally low in Oyo (Figure 5). Using reported income, mean per capita income is ₦618/person/day (US$ 2.0) with a median per capita income ₦362/person/day (US$1.2). Using consumption (expenditure) data, mean per capita income is ₦844/person/day (US$2.8) with a median income of ₦537/person/day (US$1.8). When consumption data is compared with international poverty lines, 34% of households in Oyo are below the poverty line of US$1.25/day, while 55% of households are below the US$1.90/day poverty line. Income levels are however likely underreported as have been seen in other studies in developing countries, since income is subject to recall and there are no objective verification ways e.g., income tax returns.

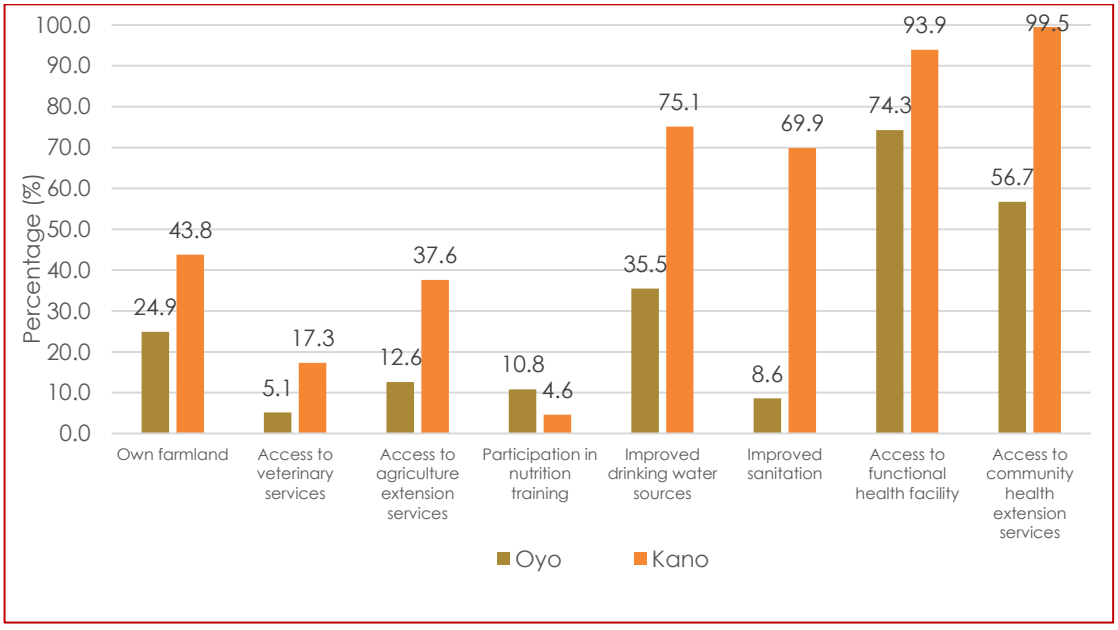
Furthermore, less than 30% of households in Oyo have access to services and factors that can increase their productive capacity, such as land and veterinary and extension services. Sanitation and sources of drinking water are very poor with less than 10% of households using improved sanitation. Access to functional health facilities and community health extension services are a lot higher at 74% and 57% respectively. Still, many households do not seek formal healthcare services due partly to physical access. 99% of households in Oyo have to take a vehicle or a motorcycle for a mean of 54 minutes (median of 45 minutes) to get to the health facility. Drinking water sources are also a distance away. On the average, households with improved drinking water sources have to walk for 24 minutes to fetch water and return home, while households with unimproved drinking water sources have to walk an average of 46 minutes to fetch water and return. For care resources, 11% of households in Oyo reported having attended nutrition training in the year preceding the survey. More than half of these households (57.7%) reported that the training was received from the milk processor to which they supplied milk. However, milk processor informants stated that training had been focused on animal nutrition; human nutrition education has been ad hoc and informal. Other sources of training mentioned include health centres and mosque events.

Resources for food security and care are also inadequate in Kano, though better than in Oyo. Using reported income, mean income in Kano is ₦616/person/day (US$2.0), with a median income of ₦236/person/day (US$0.78). Using consumption (expenditure) data, mean income is ₦1,333/person/day (US$4.4) and median income is ₦857/person/day (US$2.8). Still, 12% of households are below the poverty line of US$1.25/day, while 27% of households are below the US$1.90/day poverty line. Care resources are especially poor, with just 5% of households reporting having attended nutrition training in the year preceding the survey. All the households who reported

attending training noted their community as the source of the training. Access to resources for health were ≥70% for improved sanitation and drinking water source. Households that have improved drinking water source have to walk an average of 8 minutes to fetch water, while households with unimproved water sources require 10 minutes to fetch water. There is nearly universal for access to functioning health facilities and community health extension services (Figure 5). Nevertheless, there are physical limitations to the available resources. Functioning health facilities are an average of 31 minutes away for 97% of households who have to take a motorcycle/tricycle/vehicle to access these facilities.

The differences between Oyo and Kano are statistically significant ($p<0.05$), except for reported income. In addition, it should be noted that households with unimproved drinking water sources are significantly more likely ($p<0.001$) to do something to make their drinking water safer to drink. Thirty-seven percent (37%) of households with unimproved water sources acted to make drinking water safer, compared with 14% of households with improved water sources. The use of alum (29%) and leaving the water to settle (35%) are the primary things done to make drinking water safer. Boiling (4%) and filtering (1%) are a lot less common.

Figure 5: Household Access to Resources for Food Security, Health, and Care (%)



Overall, the perceptions of key informants support a poor nutrition situation among the smallholder dairy producing households. Several of the key informants stated that dairy farmers are malnourished, with a perceived prevalence ranging from 20% to 50% in Oyo and Kano respectively. According to the informants:

"I may not be able to support my observation with any evidence, but I noticed that some of them are malnourished. We go there often for extension work so when we go there, judging from what they eat, you know they are malnourished. Most times they eat tuwo in the morning, afternoon and night and sometimes they drink nono. Some of them look very lean while some appear to be healthy." (KII9, AEO, Oyo)

Malnutrition contributory factors that key informants mentioned included poor personal hygiene and WASH conditions; inadequate use of health services; and inadequate food purchase and consumption decisions. As described by key informants:

Poor Personal Hygiene & WASH Conditions:

"The environment contributes to their malnutrition – as a result of contaminated food or water" (KII22, AEO, Kano)

"…They have a problem of good hygiene and dirty, non-hygienic water. The water is used to irrigate farms and has plenty of germs, yet they still drink it" (KII24, AEO, Kano)

"The parasites are in the water; when they drink it, they have typhoid or something like that; they are not good, they have no good drinking water. Even those close by also get diseases" (KII27, AEO, Kano)

"They do not have wells or boreholes, just streams and the streams are far. Perhaps that is one of the reasons most of them are dirty and some of them don't bath regularly" (KII11, NFP, Oyo)

Inadequate Use of Health Facilities

"… Like 30% among them deliver in health facilities. Most of them don't even like to deliver in the hospital set up, they prefer to deliver at home until maybe they cannot handle the case that is when they come to the hospital. I don't know if it is against their culture. When they come to clinic and you try to examine them they tell you no and close their laps." (KII10, NFP, Oyo)

"Like 10% come for ante-natal … 2% for delivery … It is not the distance, they don't believe in delivering in the hospital." (KII10, NFP, Oyo)

"If at all they end up coming, you have to persuade them very well or maybe the case is very severe before they bring the baby …" (KII13, NFP, Oyo)

Inadequate Food Purchase & Consumption Decisions

"The people in the area, most of their foods are centred towards carbohydrates. Even though they take soybeans or vitamins at times, 85% of their food is centred towards carbohydrates" (KII12, AEO, Oyo)

"Inadequate diet intake. They do not eat what will give them proper diet – e.g. beans, vegetables, rice, yam, eggs, etc." (KII16, NFP, Kano)

"You know most of them are farmers. They plant their food … like this Fulani people, I think. You know I didn't stay there. I only go there to visit them. And, you know their food doesn't pass tuwo or with fura de nunu and they drink fresh milk. They believe in that. But like the people in our community, their food is rice, like tuwo shinkafa, tuwo monsara and … traditional food" (KII16, NFP, Kano)

"The Fulani people in Kura have many things that they are supposed to do, they have their animals, they have their farms, so they use that milk that they get from this their animals, so if they use that money in a good way they can provide them their nutrition, but the problem is that if they are selling their milk instead they buy at least good food like meat or egg something like that

where they produce good nutrition for them, they cannot they gathering their money to buy another cow to add to their cows" (KII27, AEO, Kano)

"The availability is the only factor that I can say affects it. This is Ibarapa, not their own land. They have come to Ibarapa to settle down and the food in Ibarapa is different from their own food that they are used to in their own place. If that staple food is not available here, that is the only hindrance that I think can influence it" (KII8, AEO, Oyo)

Key informants had diverging views regarding malnutrition levels among smallholder dairy farmers in Oyo and Kano. Many who regard them as healthy cite their milk consumption as a key factor contributing positively to their nutritional status.

"Some of them eat well while some of them don't. This is because some of the cases they bring from there; two weeks ago we saw a baby that was seriously malnourished. During series of tests, some of them look very pale while some look okay. So perhaps 70% nutritionally ok." (KII11, NFP, Oyo)

"Sometime when you go to their communities you will think you meet their children somehow. But you will see them healthy. But among them you will get some that are malnourished" (KII16, NFP, Kano)

"…Really healthy means that someone who is physically fit, sound mentally, capable of doing his daily activities. Fulani people are mentally fit, physically fit mentally sound and they can do their day to day activities" (KII22, AEO, Kano)

From their own aspect and from my observation, they are healthy; it is to my understanding that, mostly their meal used to be milk and cereals and we cannot compare them with what we are eating in the towns/urban areas. This milk is okay for them, and they are healthy looking (KII22, AEO, Kano)

"I used to go out to their Gaa at times for immunization and what I can say contributed to their good nutritional level is because they take cow milk raw, although it is not hygienic. Again, they grind millet and groundnut mixed with some other things and they eat fresh vegetables. Some of them aside the fact that they are cattle rearers, they farm, and these farms are located beside their Gaa" (KII11, NFP, Oyo)

"The milk has added advantage to their food in the sense that it contains vitamin, proteins and minerals. The only disastrous area I think we should take note of is the cooking aspect of it because if it's not properly cooked zoonosis may be the outcome" (KII12, AEO, Oyo)

"Some crops grown are enough for them to have good nutrition" (KII16, NFP, Kano)

Access to Resources for Animal Heath

Another issue that was emphasized by key informants was the challenges the communities faced accessing productive services, especially as related to access to vet doctors, drugs & vaccines for animal care and government support. According to key informants, farmers typically mange visits to/from vets on their own or with some support from the processors. They also typically purchase and administer drugs and vaccines for their animal care. Some communities have not been visited by government agricultural extension officers in more than three decades but have received assistance from the processors. Nevertheless, as part of the NDDP, government extension officers

started visiting some communities to conduct trainings shortly before the data collection for this study started.

Access to Vet Doctors:

"There are no veterinary doctors in the association, although the association could assist members in good standing after they have spent a lot of money on treating their animals" (KII19, HCA, Kano)

"…Initially when they started, we had a vet doctor always around but currently we have none. In fact, anything agriculture, we don't enjoy from the government" (KII25, HCA, Kano)

"… The association calls FCW and they send vets. Once they are summoned, they go visiting every herdsman where they are in their hamlets (IDI5, HCA, Oyo)

Access to Drugs & Vaccines

"We only go, buy medication and then are taught how to administer the treatment" (KII29, HCA, Kano)

"Cattle owners go to the market to buy drugs, sometimes go to Kaduna if the issue is much" (KII25, HCA, Kano)

"The rearer buys with their money, in every market there are vaccine sellers" (FGD 5, men, Oyo)

"The owners of the animals buy the medication" (IDI13, CL, Kano)

"We have those that deal on medication. And you can go anywhere to buy and sell, no compulsory market selected" (KII28, HCA, Kano)

"Members buy medication and also invite vet doctors to come check the animals. The government has abandoned us for over 3 years now, so we sort ourselves out" (KII28, HCA, Kano)

"Herdsmen mostly administer medicines to their cattle on their own since they have experience with animal health and disease conditions. They simply go to the pharmacy, explain to the pharmacist and get drugs for their animals. If the sickness is major, they would call a vet (KII4, HCA, Oyo)

"For vaccination, cattle rearers typically conduct them on their own unless they need to get a veterinary doctor involved by the processor, or at their own cost"

"Animal vaccination typically done by herdsmen unless it's a hard nut to crack then inform FCW to come and take a look" (IDI5, HCA, Oyo)

Access to Government Support & Extension Services

"The government used to vaccinate the animals before but not anymore" (IDI1, HCA, Oyo)

"Not seen any [agriculture extension workers] for 32 years (KII19, HCA, Kano) ……Not come in 2 years (IDI5, HCA, Oyo)

"The local government has not helped in any way and the state government has not appointed anyone, though they helped with a huge loan to expand farms" (KII25, HCA, Kano)

"The farm agents are supposed to give chemicals, teach how to use them, bring fertilizers etc. The agents come two times a month, but the government has totally forgotten farmers in the area of fertilizer "(KII28, HCA, Kano)

3.3 Food Systems Characterization and Factors that Influence Food Choices

3.3.1 Food consumption patterns

In the three months preceding the survey, cereals, non-leafy vegetables, and fats and oils were the food groups most reported to be have been consumed daily by households in both Oyo and Kano States (Tables 6 & 7). In Oyo, fish, eggs and fruits are the food groups least consumed daily. In fact, around a quarter of households in Oyo reported consuming fruits, eggs, and fish rarely to never; and another 15% and 12% respectively reported consuming meat and legumes rarely to never over the 3 months preceding the survey. In Kano, eggs, meat, and fruit are the food groups least consumed daily. Meat and eggs were respectively reported by 12% and 17% of households in Kano as food groups that are rarely or never consumed. These findings were corroborated by FGDs participants' description of food consumption patterns. In both Oyo and Kano States, respondents stated that meat consumption usually occurs during major events, for various reasons. In the words of participants:

'We don't eat meat like that until there is an occasion" (FGD 5, men, Oyo)

"Sometimes even a whole week passes without you eating meat, so not everyone eats meat. Only those that get the opportunity to eat it. If you have your money, you can eat it every day." (FGD 17, women, Kano)

"Like me now I don't have chicken so where will I get chicken to kill? All these things are just to satisfy desire." (FGD 5, men, Oyo)

"If we eat meat always then you won't be seeing any cattle around. We rear them because of what we get from them. All the hard times we survive is because of the proceeds we get from it. So, tell me if we catch them and eat always, how are we going to survive?" (FGD 5, men, Oyo)

"This is because if you take cow milk often you will be disinterested in meat. The cow milk we take is what makes us lose interest in eating meat" (FGD 1, men, Oyo)''

Table 6: Food Consumption Patterns among Smallholder Dairy Producers in Oyo State

Food Group	Frequency of Consumption				
	Daily (%)	Weekly (%)	Monthly (%)	Rarely (%)	Never (%)
Cereals	90.5	8.8	0.7	0.0	0.0
Tubers	45.3	42.2	8.1	4.4	0.0
Legumes, Nuts & Seeds	28.0	45.3	15.2	10.8	0.7
Dark Green Leafy Vegetables	78.6	19.0	1.7	0.7	0.0
Non-Leafy Vegetables	88.1	10.6	1.0	0.3	0.0

Food Group	Frequency of Consumption				
	Daily (%)	Weekly (%)	Monthly (%)	Rarely (%)	Never (%)
Dairy	75.6	17.3	4.1	3.0	0.0
Fruits	23.3	32.4	18.9	24.7	0.7
Meat	37.2	36.1	12.2	14.2	0.3
Eggs	20.7	37.2	17.5	20.0	4.6
Fish & Seafood	20.5	35.8	15.3	19.8	8.7
Fats& Oils	80.4	14.8	3.1	1.7	0.0
Miscellaneous (Sweets, Condiments & Beverages)	71.9	17.8	4.5	5.8	0.0

Table 7: Food Consumption Patterns among Smallholder Dairy Producers in Kano State

Food Group	Frequency of Consumption				
	Daily (%)	Weekly (%)	Monthly (%)	Rarely (%)	Never (%)
Cereals	95.2	4.8	0.0	0.0	0.0
Tubers	17.9	64.3	15.9	1.9	0.0
Legumes, Nuts & Seeds	39.2	53.9	6.4	0.5	0.0
Dark Green Leafy Vegetables	74.6	24.9	0.0	0.5	0.0
Non-Leafy Vegetables	95.1	4.9	0.0	0.0	0.0
Dairy	80.3	14.8	0.5	3.4	1.0
Fruits	27.5	38.7	32.3	1.5	0.0
Meat	21.1	51.5	15.2	9.8	2.4
Eggs	18.3	37.6	26.9	10.8	6.4
Fish & Seafood	32.9	54.7	3.1	6.2	3.1
Fats& Oils	99.0	1.0	0.0	0.0	0.0
Miscellaneous (Sweets, Condiments & Beverages)	61.1	25.6	7.4	5.9	0.0

There are significant gaps when the food groups consumption patterns are further collapsed into the five food groups that the US and South African FBDGs recommend be consumed daily – cereals/tubers; legumes; vegetables/fruits; meat/fish/eggs; and dairy – (Table 8). Just 19.9% and 15.5% (p=0.20) of households in Oyo and Kano respectively meet the FBDGs by consuming each of these five food groups daily. When the MDD-W data is collapsed into these five food groups, the consumption gaps are even larger. Merely 6.9% and 4.5% (p=0.28) of households in Oyo and Kano respectively achieve the FBDGs.

Table 8: Percent of Households that Consume each FBDG recommended Food Group Daily

	Using Food Frequency Data		Using MDD-W Data	
	Oyo	Kano	Oyo	Kano
Cereals/Tubers	91.9	100	100	100
Legumes	28.0	39.2	29.2	69.9

Vegetables/Fruits	93.2	99.5	99.6	99.4
Meat/Fish/Eggs	48.0	39.7	41.5	29.3
Dairy	75.6	80.3	38.1	14.1

3.3.2 Intra-household Household Food Distribution and Gender Roles in Household Food System

About a quarter of households in both states reported prioritizing one or more family members when serving food (Table 9). Among households who prioritized specific members differently, husbands (household heads) are generally reported to be prioritized as a sign of respect. However, a few women reported prioritizing their husband to get his attention. In the words of one woman "*special treatment is given to get husband attention. He can be served with 2 or 3 meats while others with one each*" (R406, Oyo State).

There are significant differences in gender influences on household food systems between Oyo and Kano. In Oyo, women are most frequently reported to be the primary influencer of foods prepared by households, while in Kano, the men are (Table 9). Key informants in Kano noted that men are the primary decision makers around food in smallholder dairy farmer households. They indicated that husbands decide first, and the wives decide next. In both states, the men (husbands) are the primary provider of food money and primary purchaser of foodstuffs; but significantly more women in Oyo than in Kano also play these roles. Few men indicated being the primary preparer of food, which happens during migration. (Table 9).

"The husband dictates what they cook in the house, most of them" (KII16, NFP, Kano)

"The father decides" (KII24, AEO, Kano)

"The husband – he is the one dropping the money" (KII22, AEO, Kano)

Table 9: Characteristics of Food Systems in Smallholder Dairy Producer Households

Characteristic		Oyo State (%)	Kano State (%)
Household engages in crop production	Yes	94.1	99.0
	No	5.9	1.0
Use of crops produced by households	Sale	33.7	49.2
	Consumption	17.6	31.1
	Both sale and consumption	48.7	19.7
Household engages in small animal husbandry	Yes	94.0	93.5
	No	6.0	6.5
Use of small animals kept by households	Sale	15.4	8.8
	Consumption	9.4	61.7
	Both sale and consumption	75.2	29.5
Primary provider of food money	Husband	73.2	94.6
	Respondent woman	21.6	5.4
	Others	5.2	0.0
Primary purchaser of foodstuff	Husband	66.4	75.6

Characteristic		Oyo State (%)	Kano State (%)
	Respondent woman	30.2	24.4
	Others	3.4	0.0
Primary influencer of food prepared	Husband	37.6	58.1
	Respondent or another wife	60.5	41.3
	Extended family	1.9	0.6
Primary preparer of food	Husband	3.5	8.8
	Respondent woman	92.0	91.2
	Another wife	4.2	0.0
	Others	0.3	0.0
Differences in intrahousehold food distribution	Yes	26.0	24.5
	No	74.0	75.5

3.3.3. *Drivers affecting food choices*

Food choices are heavily influenced by food availability, accessibility and affordability. They are also influenced by migration, education and knowledge, tradition and culture, and accessibility and storage infrastructure.

Food availability

Although a minority of households surveyed own land, nearly all households reported being engaged in crop production (Table 9), with farm land commonly rented. The foods preferred and consumed are heavily dependent on the crops planted. Still, some households sell all the food they produce without keeping any for their own consumption. At least half of the households in each state reported consuming some or all the crops they grew, but a substantial percentage – 34% in Oyo and 49% in Kano – reported selling all the crops they produced. Nearly all households also own other livestock (sheep, goats, or poultry) in addition to their cattle (Table 9). These livestock are almost always sold, with consumption of own livestock reportedly occurring only during special occasions. Key informants' reports are consistent with the survey findings as they report that households prefer and consume foods that are locally grown, and that households sell some or all of the foods that they produce. Markets accessed by households in both states have an abundance of foods from all food groups. Households purchase food items that they do not produce.

The commonly produced crops reported by key informants are also consistent with those the households reported growing. These crops include maize, yam, tomatoes, millet, cassava, soybean, sorghum, groundnuts, guinea corn, rice, and beans. Respondents reported the following regarding food production and usage behaviours among smallholder dairy households:

"*'They are farmers, so they usually practice subsistence farming together with this pastoral farming. When they plant their arable crops, it's mostly for consumption; so, to say they are not food secured is not the total true. They only don't eat balanced diet, but they have something to eat and mostly produced by themselves.*" (KII10, NFP, Oyo)

"Take for example, maize. Some keep it in crib, silo, some bag it and add food preservatives. However, because yam is common some people eat pounded yam all year round. So, in terms of food security, there is no problem with that. Cassava at times is peeled, sun-dried before keeping it somewhere and it will be okay throughout the year" (KII12, AEO, Oyo)

"…They prefer to go and sell produce… They sell it and buy the ones they don't have, e.g. if they have corn and they need rice and macaroni. They will take it to the market and sell the ones they have (just like they exchange) and then buy the ones that they need" (KII16, NFP, Kano)

"After harvesting, they reserve some that will be used in, they reserve enough for them to use throughout the season and they sell the remaining one to get income" (KII22, AEO, Kano)

"Some farmers sell all because there are so many needs in the family, some leave some, some don't sell any" (KII24, AEO, Kano)

"They sell some of their products. They plant cassava, millet and maize. They plant yam too. So, they eat and sell" (KII10, NFP, Oyo)

"We eat most of these things because we farm these things, instead of going to the market to buy them, we would rather buy what we don't farm. The food makes us strong." (FGD 17, women, Kano)

Food Accessibility and Affordability

Food is abundant in the major markets used by study households. Although these markets have tarred access roads, well-structured stalls, water supply and shops with locks, they are not readily accessible as they are on average at a distance of about 50 minutes by foot from most households in both states. Many communities in Oyo in particular are in what may be considered extremely rural areas deep in the interior parts of the state.

High levels of poverty, large family sizes, and food prices are noted as major challenges affecting purchases and consumption of adequate diets. Respondents had different perceptions around food affordability and price stability due to seasonality. Some noted issues with affordability, while others pointed to prioritization.

"Also, they have the problem of money… as a limiting factor to get the kind of food they are supposed to eat. But the food is available at the market and it's accessible and the prices are stable… Some of the farmers sell all their harvested crops because of their many needs in the family. Some farmers keep some, others didn't sell to anyone." (KII24, AEO, Kano)

"...because with reference to this area, food is so scarce and the little one available is so expensive. Some of them could not even afford to buy it, so they manage to buy it until August when yam will be available." (KII13, NFP, Oyo)

"The food is cheap to get, and accessible" (FGD 13, women, Kano)

"It's not so expensive in this time, but in the next two to three or five months, they would be highly expensive." *(KII, Kano)*

"…The food is affordable for them to buy but they need to be enlightened." (KII, Kano)

"The prices are stable." (KII, Kano)

Apart from the food itself, availability of and access to cooking fuel is another issue affecting food consumption. Firewood is the cooking fuel for 96% and 98% of households in Oyo and Kano respectively. 80% of households in Oyo reported cooking fuel to be

readily available while only 40% of households in Kano reported availability. In Kano, 60% of households reported that cooking fuel is accessible with some difficulty.

Migration

During migration, the Fulani travel with fewer varieties of food and are limited to these varieties while in transit. When stocks are depleted, they either send someone back home to get more food or purchased it. However, food purchased during migration is reportedly more expensive, which may affect the quantity and quality of food consumption. Discussants stated the following regarding food accessibility and affordability during migration:

''Usually, we take our millet that we have already milled and cook by ourselves at our stops. Sometimes we take garri along if we travel long distances." (FGD 10, men, Oyo)

"What happens often is that once you are getting set to move with the cattle, you buy good nylon bags and pack boiled dried millet, palm oil, measure rice and beans, sometimes garri and some amount of money for the journey. Sometimes we go for 3 months then come back. Whenever you get good vegetation, you stop there for a while for the cattle to feed on it. The reason why we go with boiled dried millet and garri is because sometimes, rain might not allow you to cook using firewood, so you eat either the garri or the boiled dried millet mixed with milk." (FGD 14, men, Kano)

"Our children are the ones on the move with the cattle and they return home beginning of rainy season…Once it is summer, we make DAMBU from guinea corn and sun-dry it so that it doesn't spoil. The children take the DAMBU along with them, they mix it with water and milk gotten from the cow to eat. Also, they go along with raw rice and beans which can be cooked at any time. When it finishes, they buy from the nearest town. (FGD 14, men, Kano)

"For our journey, we go with ground guinea corn and boiled dry millet. As for other food stuff, we leave all at home when embarking on this journey. We have our kettle where our mixed food is always kept, it is hung on our neck, so even on motion we can just eat out of it." (FGD 16, men, Kano)

"Whenever you are out of money and food, you either send people home to get more food or you sell one of your cattle. Often, the food stuff we buy on the move are more expensive than it is when we are home." (FGD 14, men, Kano)

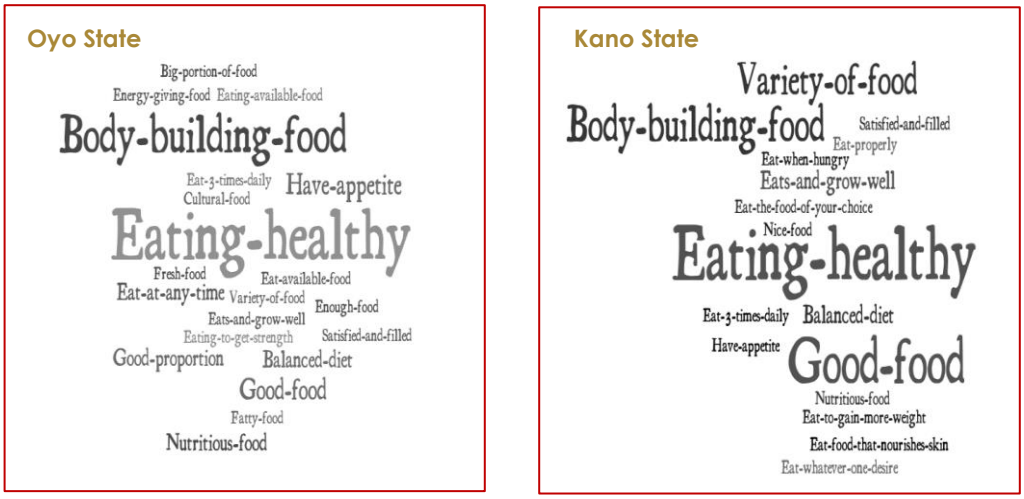
"We prepare some of these foods and take along with us. Oftentimes, we send people back to town to get these foods for us and then we prepare them. But truth is the movement limits what we have access to eat." (FGD 12, men, Kano)

Education & Knowledge

Even when food is available, accessible and affordable, respondents' knowledge about the importance and adequate combinations of food is critical to healthy eating.

It does not immediately appear from the household questionnaires that the Fulani lack knowledge about adequate diets. When households were asked to state what they understand by the term "eating well", "*eating healthy*" and "*body building food*" were the most frequent definitions used in both states. In Kano, "*good food*" and "*variety of food*" were also commonly used. Figure 6 shows a word cloud of the definition of eating well by smallholder dairy farmers in Oyo and Kano States.

Figure 6: Word Cloud for Definition of Eating Well in Oyo and Kano



Key informants in both Oyo and Kano States however perceive nutrition knowledge to be inadequate:

"Now, being an illiterate, some of them believed they must just eat; they might actually eat, but not the food needed for their body and that is the reason why most of them are malnourished. Take for example, somebody who eats carbohydrate in the morning, afternoon and evening" (KII11, NFP, Oyo)

"…despite the food being available to them, they are not aware of the importance of the food …" (KII22, AEO, Kano)

"Ignorance of the importance of proper diets" (KII24, AEO, Kano)

"Ignorance. If they have good food they are supposed to eat, they end up selling it." (KII13, NFP, Oyo)

"Because some of the Fulani are illiterate, didn't attend school that is the major problem we are facing. Many young boys don't attend school" (KII24, AEO, Kano)

"Ignorance and illiteracy; There is a need for reorientation" (KII9, AEO, Oyo)

"What I observed is perhaps their level of education and two, their poverty level; three could be their system of marriage – 25/30 years old have two or three wives. Catering for them properly would be difficult. These are all factors that could affect their nutrition status. Although some of them want to eat good food. That is why they produce maize and rice, these are crops they eat most" (KII9, AEO, Oyo)

Tradition, Religion & Culture

Tradition, religious and cultural values also play a major role in the choice of food. In many instances, people reported that their diets were driven by food traditionally consumed. They also noted refusal to consume certain foods because they were not acceptable due to culture or religion:

"There is no special reason for consuming foods but since that is the food we were brought up with, then we continue with it" (FGD 3, men, Oyo)

"It's because we have gotten used to eating the food, we grew up eating it. We eat others also but not as often as we eat tuwo" (FGD 1, men, Oyo)

"… Culture determines the norms, conduct of the society. Good enough in Kano, 99% of the population are Muslims so at times the culture intertwines with religion. There are some foods that are not eaten culturally, it is not prohibited but it's the culture. In terms of this, the culture won't let us take it." (KII32, HCA, Kano)

"… Let me say as we need this pork, snail. Most of the Kano dwellers don't take pork and snail as part of the food. These foods are good, but the culture ignores it. Even with the high nutritional value even though some culture eats it even as supplements in their dinner. So, this is culture. At the same time with religion as 99% Hausa Fulani dominates Kano, we are not allowed to eat pork in as much as pork is nutritious it is prohibited. Since it's prohibited culturally, the religion must prohibit it. Whether in Kano or not, as a Muslim all over the world, it is prohibited. Also, donkey and horse are prohibited religiously so we ignore culturally." (KII32, HCA, Kano)

"Our religion does not permit us to eat such …" (FGD 15, women, Kano)

"Our religion does not support eating pork, goat, death animal but people eat chicken, and fish unless your lifestyle is different." (FGD 2, women, Oyo)

"Islam does not permit us to eat them" (IDI1, HCA, Oyo)

"…we don't eat goats because of the smell, we don't eat dog, pig because of religion…." (IDI3, CL, Oyo)

"Most of these Fulani, they forbid to eat goat meat. Walahi, I don't know. Then, dead meat, dog. Ah! No, they don't. You know in Islam, it is not good to eat something that is dead, then, you now swallow it." (KII16, NFP, Kano)

"I don't think there is any food they do not eat with the exception of the foods their religion forbids them to eat; swine, pig. Religion does not allow them to eat dog and horses with donkeys. They also don't eat animals that are dead without being slaughtered" (KII21, MP, Kano)

Data collected at the household level indicates that the most common food taboos are eating meat from pigs, dogs and dead animals (Figure 7). Generally, food restrictions applied to every member in the households and not just some demographic group. Specifically, for pregnant and lactating women, 11% of households in Oyo and 1% of households in Kano reported some foods to be avoided. However, it appeared that the restrictions are idiosyncratic rather than norms, as very few (average of 3 persons surveyed) reported each restriction. Foods that were mentioned for pregnant women to avoid include bitter food, bread, bush meat, eggs, soft-drinks, garri, milk, salt, sugar, and heavy starchy meals.

Figure 7: Word Cloud on Food Taboos in Oyo and Kano State

In addition to the above, idiosyncratic factors such as phobias and unpleasant physical effects such as allergic reactions to food, influence food choices:

"Some among us don't eat fish amidst the Fulani enclave at all. Even some among us, when they get to where fish are sold they have phobia…" (FGD 8, men, Oyo)

"… When some of us eat it, we have sight problem" (FGD 8, men, Oyo)

"Some people are not aware of foods that are forbidden to them. You know some people after eating chicken experience itching ear. Therefore because of this allergy some people don't take groundnut oil … Even red oil... These things are not taboo just that some people don't eat it because they are allergic to it." (FGD 8, men, Oyo)

3.4 Potential Entry Points for Improving Smallholder Dairy Producer Households Nutrition

3.4.1 Own consumption pathway

The hypothesis testing the relationship between increased production and consumption found that there is a significant and positive correlation between volume of household's milk yields and volume of milk consumed per capita. This means that households that produced more milk generally consumed more milk per person. The median volume of milk produced by households in Oyo and Kano is 30 litres/day (mean 70 litres/day) and 25 litres/day (mean 33 litres/day) respectively, while median volume consumed is 0.50 litres/person/day) and 0.67litres/person/day respectively. Spearman's ρ between milk production and consumption in Oyo and Kano was 0.30 ($p<0.0001$) and 0.33 ($p<0.0001$) respectively. It is worth mentioning that the differences in mean milk production between the two states is statistically significant ($p=0.003$). The differences in milk consumption between the two states is however not significant ($p=0.66$). There is also no significant difference in the volume of milk consumed by integrated versus non-integrated households in either state.

3.4.2 Income pathway

There appeared to be no relationship between income and MDD-W, regardless of whether income was measured using reported income or household expenditure. There also appeared to be no relationship between income and BMI. The chi-square statistic

for associations between per capita income quintiles and MDD-W; and per capita income quintiles and BMI categories were generally not at all significant (p≥0.1).

3.4.3 Market/prices pathway

The study found a very strong positive relationship between volume of household's milk yields and volume of milk offered for sale, indicating that increased milk production will increase market supply of milk. The median volume of milk sold in Oyo and Kano is 25 litres/day (mean of 40 litres/day) and 22 litres/day (mean of 29 litres/day) respectively. Spearman's ρ for the correlation between volume of milk produced and volume sold was 0.90 (p<0.0001) for both Oyo and Kano States. The differences in mean milk sold between the two states is significant (p=0.0175).

It is worth mentioning that the volume of milk reportedly sold daily by 12 (4%) households in Oyo, and 3 (1.4%) households in Kano, was equal to 100% of the milk they produced each day, implying that none of the milk produced was kept for household consumption. All the households that had volume of milk sold equal to volume of milk produced are integrated households.

3.4.4 Women's status pathway

There is no statistical difference (p=0.22) between the volume of milk produced by integrated households versus non-integrated households in Oyo. Whereas integrated households reported producing a mean of 74 litres of milk per day, non-integrated households produce 51 litres per day (there was a lot of variations around the estimates, leading to wide confidence intervals). In Kano, integrated households reported producing 35 litres and sell 30 litres of milk daily, while non-integrated households produce 31 litres and sell 22 litres of milk daily. The differences between volume produced and volume sold for integrated versus non-integrated households in Kano is also not statistically significant (p>0.05). When the milk sold is computed as a proportion of milk produced and compared by integration status in the two states, it is found that integrated households in Kano sell a significantly (p=0.016) higher proportion of the milk they produced than non-integrated households. While integrated households in Kano sell 78% of the milk they produced, non-integrated households sell 64%. It was not possible to assess the relationship between integration status and proportion of milk sold in Oyo because only 1 non-integrated household reported the volume of milk sold in this state.

The mean daily milk income reported by households is ₦632 (median ₦329) and ₦2027 (median ₦968) in Oyo and Kano respectively; the difference between the two states is significant (p=0.0008). In Oyo, integrated households earn an average of ₦643 daily from milk, while non-integrated households earn ₦570, but this difference is not significant (p=0.67). Similarly, integrated households in Kano have a mean daily milk income of ₦1617, while non-integrated households report N2450 daily, but these differences are not statistically significant (p=0.43).

In Oyo State, there is a significant association (p=0.002) between milk income tertiles and whether or not a woman met MDD-W. In the lowest tertile, 56% of women met MDD-W, compared to 72% and 84% of women in the middle and highest tertiles respectively. In Kano, although 61% of women in the lowest tertile met MDD-W, compared to 67%

and 66% in the middle and highest tertiles respectively, there appeared to be no statistical association between milk income and MDD-W (p=0.89).

As previously mentioned, Fulani women in Oyo appear to participate significantly more in decision-making around food than women in Kano. A significantly higher percent of women in Oyo are the primary provider of food money, primary purchaser of food, and the primary influencer of foods prepared in the household. Still, there is no significant association (p>0.05) between any of these indicators of women's status and MDD-W or BMI category in either state.

The higher income from milk in Kano, despite lower volumes of milk sold than in Oyo, appear to be due to the price per litre of milk. There are price variations between and within states. Prices range from ₦105 per litre in Oyo to up to ₦220 per litre in Kano; with households in Oyo receiving ₦90 per litre and milk collectors gaining ₦15 per litre. The NDDP processor who bought milk from dairy households in Kano, L&Z, moved from fixed pricing to market-based pricing in early 2017. Respondents indicated that some households stopped supplying milk to the NDDP processors because of lower-than-market-prices paid and suggested that increases in prices will encourage dairy producers to supply to the processors. The price comparison between the processors and the informal market however does not account for the cost incurred by households to transform the raw milk into milk products and to transport them to the market.

If they increase the price, our other members will come back to the business which will be an added source of income" (KII14, HCA, Oyo)

"*They should give us a price that will match whatever everyone can offer or agree to*" (KII29, HCA, Kano)

"*We advise them to continue selling to avoid waste, it is better to have money you are expecting than not to even have hope*" (KII29, HCA, Kano)

"*If we can get increased payment, we will in turn add what we pay to the sellers, which will make them happy and eventually cater for cattle even more*" (KII25, HCA, Kano)

Respondents also noted that there are milk preservation and transportation challenges associated with supplying the processors, and that payment terms are a limiting factor.

"*…if a means of transportation can be provided to help transport milk from far distance to the company will be a good one.*" (KII28, HCA, Kano)

"*Payment of milk should be regular and instant. The solution to this is for the company to pay as you deliver, because this would encourage the sellers to always meet up with time if they want to make some money*" (KII19, HCA, Kano)

"*…If possible, if we have a refrigerator where we store this milk always until the company comes to get them, it will help us a lot.*" (KII31, HCA, Kano)

"*…They should increase like 30 minutes to the delivery time because of distance*" (KII14, HCA, Oyo)

3.4.5 Shared mediators

Significantly (p=0.04) more women in Oyo (11%) than in Kano (5%) reported having received nutrition training. While there appeared to be no relationship between training attendance and MDD-W in Kano, women who attended training in Oyo are statistically more likely to meet MDD-W. In Oyo, 86% of women who attended training meet MDD-W compared with 64% of women who have not (p=0.048). Similarly, there is a significant relationship (p=0.04) between use of skilled ANC during the last pregnancy and MDD-W in Oyo State. Sixty-five percent (65%) of women who received no ANC/unskilled ANC met MDD-W compared to 79% of women who used skilled ANC. There is no relationship between use of skilled ANC and MDD-W in Kano (p=0.71). There is no relationship between attendance at training and BMI category in either state.

There seems to be a direct, though not significant association between MDD-W and BMI. In Oyo, 40% of underweight women did not meet MDD-W compared to 30% of normal weight women and 0% of overweight women. In Kano, 38% of underweight women did not meet MDD-W, compared to 36% of normal weight women and 26% of overweight women.

4. DISCUSSION

The purpose of this study was to describe the nutritional situation of smallholder dairy producers in Oyo and Kano States, highlight the characteristics of their food systems and factors influencing their food choices, and identify possible food systems' entry points for improving their nutritional status.

4.1 Nutrition Situation

4.1.1 Anthropometric Status

The study found a high prevalence of malnutrition among women and children in the study households. Moreover, the Fulani households assessed seem to have a higher burden of undernutrition than the average for the states in which they reside.

According to the World Health Organization (WHO, 2010), a wasting prevalence <5% is acceptable, 5% – 9% is poor, 10% – 14% is serious, and ≥15% is critical. Based on these classifications, the wasting prevalence in Oyo is acceptable while that in Kano is critical. It is important to note though that these WHO classifications are based on wasting defined using weight-for-height z-scores (WHZ) and not the MUAC used in this study. Studies have shown that WHZ and MUAC do not identify the same children (Berkley et al., 2005). Using WHZ, the Multiple Indicator Cluster Survey (MICS) 2016/2017 (NBS & UNICEF, 2017) reported a wasting prevalence of 10.8% for Kano and 7.6% for Oyo. A previous study of Fulani children in Oyo and Ogun States (Ekpo et al., 2008), also using WHZ, found a prevalence of wasting of14%.

For women, the WHO (2010) classifies underweight prevalence of 5% – 9% as low prevalence (warning situation requiring monitoring), 10% – 19% as a poor situation, 20% – 39% as a serious situation, and ≥40% as a critical situation. These classifications indicate that undernutrition among the studied women in both Oyo and Kano is in a serious situation. Women in Kano furthermore have a poor situation, if the same cut-offs are applied to overweight levels. The mean BMI observed among the study women in Kano (21.1 kg/m^2) is comparable to the BMI reported by the 2013 Nigeria Demographic and Health Survey (NDHS) for women in Kano (21.7 kg/m^2). The mean BMI in this study in Oyo (19.6 kg/m^2) is however three percentage points lower than the mean BMI reported in Oyo in the 2013 NDHS (22.9 kg/m^2). The underweight prevalence observed among the study women in both Oyo and Kano is higher than the 2013 NDHS state averages, while the overweight prevalence among the study women is lower than the NDHS.

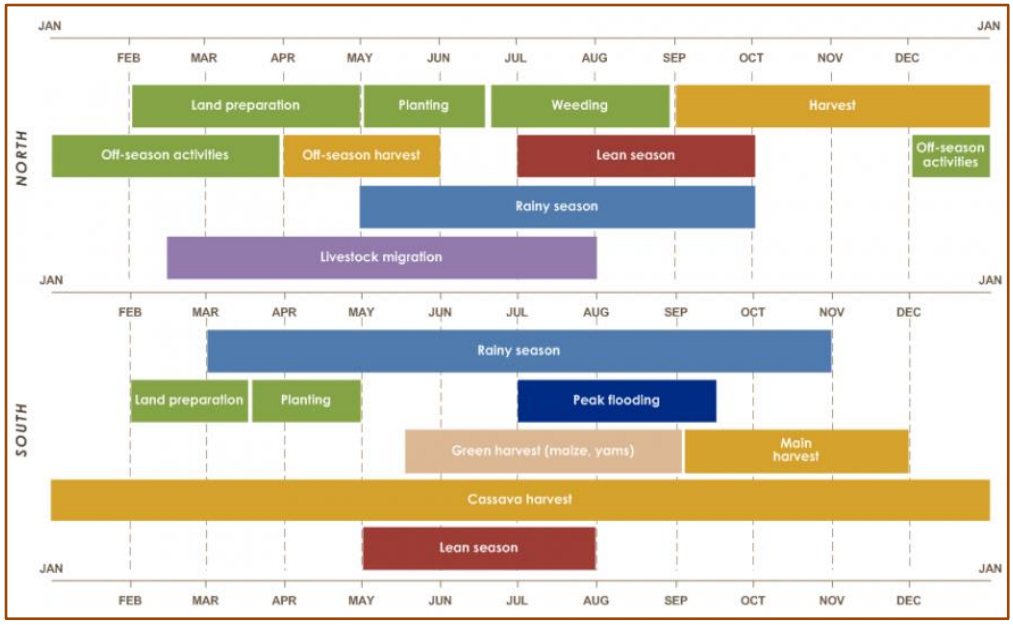
4.1.2 Dietary Diversity, Food Security and Seasonality

The immediate, underlying, and basic determinants of malnutrition assessed are poor. This study found that at least one-third of women of reproductive age do not meet the minimum dietary diversity for women (MDD-W) score of 5 food groups out of 10, reflecting probable inadequate diet quality and micronutrient intake. There are several factors that influence dietary diversity scores, including the day of the week in which data is collected, special events, and seasonality (FAO & FANTA, 2016). Figure 8 is an illustration of the seasonal calendar for northern and southern Nigeria (FEWSNET, 2018), and indicates that this study was conducted during the harvest season for both Oyo (south) and Kano (north). A study (IFAD, 2018) conducted in Katsina and Sokoto States in northern Nigeria, at the beginning of harvest, reported an average MDD-W score of 5, with 71% of women surveyed meeting MDD-W. The report further stated that the MDD-

W score was likely to reflect the highest score for the population, since vegetables and other foods are most abundant during this period.

For food insecurity and hunger, this study, which was conducted at the beginning of November 2017, reported a low prevalence in Kano. A food security and vulnerability survey (NBS & FAO, 2016) conducted at the beginning of October 2016 in 16 northern Nigerian states including Kano found a 3% prevalence of moderate to severe hunger in Kano. The prevalence of food insecurity was not assessed using the percent of households with FES≥50%. However, the average FES in Kano in that survey (NBS & FAO, 2016) was 55%, compared to the 24% in this NDDP nutrition study. Given that the lean season (when food insecurity is highest) in northern Nigeria extends until the beginning of October (Figure 8), the low prevalence of food insecurity observed among the smallholder dairy producers in this study possibly reflects the access to food from recent harvests; and indicates that food insecurity may be much higher at other times in the year. In Oyo, where the lean season ended before the data collection for this study, the relatively high prevalence of food insecurity and hunger is indeed worrisome since the data was collected during a period in which food is expected to be abundant. It however aligns with previous studies of smallholder farmer households (Adebayo, 2012) and other households (Ganiyu & Omotayo, 2016) in Oyo State, which reported a high prevalence of food insecurity. Adebayo (2012) reported a 53% food insecurity prevalence, while Ganiyu & Omotayo (2016) reported a 29% prevalence of food insecurity among the households in one LGA of the state. The month(s) of the year in which data was collected was not recorded for either of these cited studies, but they suggest that the prevalence of food insecurity in Oyo recorded in this NDDP study may be one of the year's lowest prevalence. Regarding the minimal overlap between FES≥50% and hunger in Oyo that was observed in this study, the apparent implication is that households who expend available resources to procure food, experienced no hunger; while households that experienced hunger are either choosing to spend their available resources on non-food needs, or no longer have any resources available to buy food.

Figure 8: Seasonal Calendar for North and South Nigeria



4.1.3 Health and Care

For access to care and health, it seemed that households included in the study in Oyo State are worse off than the average household in Oyo. In the 2013 NDHS (NPC & ICF International, 2014), the prevalence of zero ANC and zero child delivery assistance in Oyo was 11% and 2.3%, far lower than the prevalence found among the women in this study. The prevalence of skilled ANC, skilled delivery assistance and child delivery in a health facility are also much higher for Oyo State in general (NPC & ICF International, 2014) than observed in this study. For Kano, it appeared that the households included in this study are better off than the average household for any ANC and any child delivery assistance. In 2013 NDHS, 35% and 39% of women had received zero ANC and zero child delivery assistance respectively, close to 3 times the figures that were observed in this NDDP study. Also, in 2013 NDHS, 13% and 14% had delivered in a health facility and received skilled assistance during child delivery respectively, which were lower than the percentages observed in this study. The only indicator in which the Kano State prevalence in 2013 was higher than the prevalence in this study was skilled ANC.

4.1.4 Poverty

At the basic level of malnutrition determinants, this study found that per capita income is quite low, regardless of the indicator used to assess income. Consumption or expenditure is in fact the preferred indicator for assessing income in developing countries such as Nigeria; because it has been found to better estimate welfare than reported income as a result of the high prevalence of informal income sources that are challenging to keep track of (World Bank, 2001). In this NDDP study, the per capita expenditure is a median of US$1.8/day and US$2.8/day in Oyo and Kano respectively. The international poverty line which is used to determine prevalence of extreme poverty globally is currently set at US$1.90 per day (Cruz et al., 2015). This study found that 55% and 27% of households in Oyo and Kano are below this poverty line. When the prevalence of poverty is determined using the Sustainable Development Goal (SDG) 1 poverty line of US$1.25, the prevalence of extreme poverty is 34% and 12% in Oyo and Kano respectively. Still, these poverty lines have been criticised as being set rather arbitrarily, without adequate consideration of the cost of wellbeing (Edward, 2006; Reddy, 2008; Hickel, 2016). Even when the international poverty line is set at US$1, a study reported that an "ethical poverty line" with a focus on wellbeing should be between US$2 and US$3 (Edward, 2006).

4.2 Food System Characteristics

4.2.1 Tradition and Gender Roles

The heavy influence of culture and religion on food system characteristics among studied households is similar to what has previously been documented for smallholder farmers in northern Nigeria (IFAD, 2018). The reliance of food consumption on household's produced foods is also well documented in literature and is in fact one of the pathways that can be harnessed to improve nutrition through agriculture (Ruel et al., 2013). The issues around intrahousehold food distribution and gender roles in the household food system are also similar to what has previously been documented. A recent review (Harris-Fry et al., 2017) highlights the prioritization of men in intrahousehold food distribution in traditional communities. The report by IFAD (2018) highlights the differential role of women in the food systems in two northern Nigerian states. It was reported that women had limited participation in activities that took place outside of the home and immediate community and were thus minimally involved in the buying

and selling of food for their household. The role of men as the primary decision maker on decisions related to food was indicated. Even more than this IFAD report, the companion study to this NDDP nutrition study – *NDDP Gender Analysis of Smallholder Dairy Farmers in Oyo and Kano States* – provides extensive details about gender roles and interrelationships among the studied population.

The NDDP gender study found clearly defined gender roles in the study communities. Women are heavily involved in decision-making around childcare and minor household expenditures including daily consumables. Many women, especially first wives also may have some input into decisions around crop production, livestock rearing, and major household expenditures, depending on the extent to which their husbands consult them. Although women are heavily involved in decision-making around dairy, their roles are prominent in processing and marketing, while men, particularly in Oyo perform the bulk of roles related to animal husbandry, milking the cows and transporting milk to collection centres (for integrated households). Cattle are predominantly owned by men, while women tend to own and exercise more control over small animals like poultry, goats, sheep and rabbits. The differences between Oyo and Kano that were observed in the nutrition study persisted in the gender study, with women in Kano having more access to productive resources (such as land and livestock) than women in Oyo. Also, similarly to what was observed in the nutrition study, the gender study found that women in Oyo are actively involved in providing money for household food. The milk money earned by women in Oyo may be used by the women to purchase food for the household, whereas in Kano, women use milk money for their personal needs and the men remained the primary provider and purchaser of household food. In addition to limited decision-making ability, women also have heavy workloads. On another note, the gender study found that women lack improved equipment for milk production and formalized structures of support and are not adequately represented in existing cooperatives and associations.

4.2.2 Food Consumption Gaps

Regarding food consumption patterns, including the limited consumption of meat, a review by Randolph et al. (2007) described the relationships between livestock production and human nutrition. This review explained that meat consumption is infrequent in livestock producing households and is limited to festive periods or times when unproductive and/or sick animals are slaughtered. The study reported by IFAD (2018) also emphasized low meat consumption among producing households in northern Nigeria because animals are considered assets and rarely slaughtered for meat but are sold alive, and because there is limited infrastructure for meat preservation and storage. It is also not unusual that this study found much larger consumption gaps when food consumption was compared to food-based dietary guidelines (FBDGs) than the MDD-W cut-off. FAO & FANTA (2016) emphasize that the MDD-W food groups are not necessarily the same as those recommended by national FBDGs and that the MDD-W is not interchangeable with FBDGs but complementary. Moreover, while the MDD-W is based on consumption of any of a number of food groups, meeting FBDGs is based on consumption of all of the specified food groups. Again, the MDD-W was validated as a measure of probable micronutrient adequacy of diets and one component of diet quality; while FBDGs are focused on probable adequacy of all essential nutrients including protein and energy, and multiple components of diet quality.

4.2.3 *Institutional versus Household Perceptions*

The differences between the perceptions of government officials about the Fulani nutrition knowledge, attitude and practices (KAPs) and the households' self-perceptions is worthy of mention. Both groups of perceptions are subjective and were frequently supported with anecdotal evidence. Although the households surveyed defined "eating well" as "*eating healthy*" and "*body building food*", their definitions of these terms may be more consistent with cultural perceptions than with evidence-based definitions. The word clouds on the definition of "eating well" indicates that some of these cultural perceptions may include being satisfied and filled, eating a big portion of food, eating food of one's choice, eating any time, and eating fresh food. A large multinational study around definitions of healthy eating (Margetts et al., 1997) found that people's definitions of healthy eating are influenced by their access to nutrition and health information. Individuals with limited access to such information consistently defined healthy eating in terms that are not aligned with standard dietary guidelines for nutrition and health. Besides, regardless of the empirical facts and realities about Fulani nutrition KAPs, subjective realities which are reflected by individual perceptions are a strong determinant of actions (Rochefort & Cobb, 1994; Worsley, 2002; Gyberg & Rydén, 2011). It is therefore necessary to take both groups of perceptions into consideration when designing interventions among the studied households.

4.3 Nutrition Entry Points

4.3.1 *Production and Own Consumption*

The links between production and own consumption were examined in this study using milk production. The findings are consistent with the evidence supporting the pathway – households' milk consumption is positively correlated with their milk intake. Theoretically however, there is likely to be a point at which increased milk production has no relationship with consumption because households are already consuming all the milk that they want. In this NDDP nutrition study, per capita milk consumption is 0.50 litres and 0.67 litres per day, translating to 183 litres and 244 litres per year, in Oyo and Kano respectively. Although the U.S. dietary guidelines recommend the consumption of 0.73 litres per day (267 litres per year), this level of consumption is generally not achieved (Mullie et al., 2016). In 2016, the country with the highest recorded per capita fluid milk consumption was Iceland with a consumption of 125 litres per capita (CDIC, 2016). It is likely that the consumption levels recorded in this NDDP nutrition study were so high because it was estimated using the amount of milk kept for household use. This means that this consumption includes all dairy products consumed and not just fluid milk. The NDDP gender study reported five products that study households make from milk, in addition to drinking fluid milk. One of popular products made is *manshanu* which is butterfat, comparable to ghee. Indeed, in the 24-hour dietary recall data collected, women frequently mentioned consuming *manshanu*. However, *manshanu* is nutritionally classified as fats and oils and not as dairy (FAO & FANTA, 2016). Moreover, both the food consumption patterns data and the MDD-W results emphasize the fact that many women do not consume milk or other dairy every day. Apart from the multiple uses of milk, the non-daily consumption of milk could be due to unequal intrahousehold milk allocation, as noted by Azarri et al. (2014).

4.3.2 *Income*

This study found an apparent lack of association between income and MDD-W or BMI. Several studies have documented associations between achieving MDD-W and higher

socioeconomic status (Morseth et al., 2017; Pal et al., 2018). Studies have also consistently documented that undernutrition decreases with higher income (Strauss & Thomas, 1998; Haddad et al., 2002), and that overweight/obesity increases with higher income in countries with a per capita gross national product in the range of that of Nigeria's (Monteiro et al., 2004; McLaren, 2007). Nevertheless, there are studies that have found no relationship between socioeconomic status and MDD-W (Maina et al., 2017); as well as reports that highlight how increased income may not be associated with improved nutritional status (Herforth & Harris, 2014). One explanation for the lack of direct relationship between income and MDD-W or BMI in this nutrition study may be the strong influence that culture and religion has on nutrition and health. The effect of higher income on malnutrition is at least partly mediated by the effect of greater access to all the determinants of nutrition (Victora et al., 1986).

Yet, having greater access to all the determinants of nutrition will not translate to improved nutrition if utilization does not follow access. It is possible that in this population, the effect that higher income could have in addressing malnutrition is attenuated by the fact that individuals largely conform to the same practices regardless of household income. The apparent lack of relationship could also be because increased income is used to procure items that have no impact on nutrition (Haddad & Alderman, 2000). The NDDP gender study reported that men would buy more cattle, marry another wife, or save money with additional income. Other nutrition studies in northern Nigeria (Amare et al., 2018) similarly found no relationship between wealth and anthropometric outcomes, even after adjusting for confounding. Moreover, the dietary diversity indicator that has been validated with household socioeconomic status is household dietary diversity score (Jones et al., 2013; FAO & FANTA, 2016). MDD-W likely reflects women's status in addition to socioeconomic status (Amugsi et al., 2016).

In addition to culture and gender influences likely playing a role in the relationship between income and MDD-W and BMI, a previous study (Savy et al., 2006) reported seasonal variations in the relationship between both women's dietary diversity and BMI. The authors found that at the beginning of the lean season, which they referred to as "cereal-shortage season", there was significant association between socioeconomic status and BMI, but that by the end of the lean season, the association had weakened and was no longer significant. The differences in association were assumed to occur because BMI generally decreased during the lean season, with women of higher socioeconomic status experiencing greater reductions. The decrease in BMI was attributed to changes in diet during the lean season as well as increased workload from agricultural activities.

4.3.3 Markets, Prices and Empowerment

The relationship between volume of milk produced and volume sold is consistent with the market's pathway. However, the study also observed a possibility that greater market access, measured using integration status, may be causing households to sell even milk that should be kept for household own consumption. IFAD (2018) emphasizes the need to consider and mitigate such trade-offs when supporting households to increase market access to facilitate the sale of nutritious foods. Aspects of the women's status pathway are linked to the market's pathway since one way the NDDP empowers women is by increasing market access for the sale of raw milk. The observation that integrated households are able to sell a greater proportion of their milk than non-integrated households may be indicative of this increased market access.

There is no statistical difference between the milk income for integrated versus non-integrated households. Furthermore, households in Oyo who sold more milk even had significantly less income than their counterparts in Kano. Existing literature explains that greater household market access will increase incomes only when the markets are efficient and capture the total value of the commodities marketed (Karnani, 2007). Findings from the NDDP gender study highlight that women reported making more money when milk is processed before selling, rather than selling the raw milk to processors. It is however worth noting that they don't account for the cost of processing and transporting the milk products to the market as well as for the cost of waste when there are limited sales in their analysis. Negotiations around milk prices were undergoing at the time of the study between the dairy farmers and FCW in Oyo.

The positive association between milk income and MDD-W in Oyo but not in Kano is a possible reflection of the greater ability of women in Oyo to buy food with milk money earned, as is discussed further below. A national study in Ghana (Amugsi et al., 2016) found that women who participated in decision-making around household purchases had higher MDD-W. The lack of relationship between BMI (a multidimensional indicator) and any of the women's status indicators may be because each of the status indicators used to assess the relationship was one-dimensional.

4.3.4 Nutrition Education

The importance of nutrition education and behaviour change communication in mediating the effect of the assessed pathways on improved nutrition cannot be overemphasized. Without nutrition education and behaviour change, interventions acting on any or all of the pathways are not likely to improve nutrition (Herforth & Harris, 2014). The need for adequate and appropriate nutrition education in this NDDP nutrition study was for instance reflected in the probability that some households were selling milk at the expense of their own consumption.

Furthermore, this study found that achievement of MDD-W in Oyo, but not in Kano, was associated with whether or not women reported receiving nutrition training and whether or not women had received skilled ANC. Again, this finding may reflect the greater influence that women in Oyo have over food decisions. Worsley (2002) in a review of the relationship between nutrition knowledge and food behaviour highlighted that the relationship is affected by many factors including the opportunity and ability to use the knowledge. Significantly more women in Oyo than in Kano are the primary influencers of foods prepared in their households, suggesting a greater ability to use nutrition training. Limited opportunities and/or ability to use nutrition training may also be the reason why skilled ANC (during which nutrition education is routinely delivered) in Kano was not significantly associated with achievement of MDD-W. Another reason could be that nutrition education was not adequately and appropriately delivered during skilled ANC as assumed. Previous studies (Adeyemi & Oyewole, 2014) found that nutrition education in Nigeria is not consistently delivered during key nutrition contact points such as ANC.

4.3.5 MDD-W and BMI

There is no significant association between MDD-W and BMI in this study. Some previous studies have reported significant association between BMI and women's dietary diversity (Savy et al., 2006), while others have not (Maina et al., 2017). Savy et al. (2006) also reported that the relationship between women's dietary diversity and their BMI

varied seasonally. The relationship between dietary diversity and anthropometric indicators (such as BMI) has been a controversial issue in literature (Ruel, 2003; Jones et al., 2014a), although debates have mostly centred on child dietary diversity and anthropometry. It has been suggested that the relationship between dietary diversity and anthropometric status may be dependent on whether or not diets were high in animal source foods like animal flesh, eggs, and dairy. The indication was that dietary diversity may be associated with anthropometric status when animal source foods are part of the food groups consumed rather than when they are not. The consumption of animal source foods among the NDDP study population was low.

4.3.6 Differences between Oyo and Kano

The differences between the situation in Oyo and Kano are worth spotlighting. For nearly every determinant of malnutrition assessed, surveyed households in Kano performed better than those in Oyo. Yet, the prevalence of undernutrition is not lower in Kano, and child malnutrition is even significantly worse than in Oyo. The only area in which surveyed households in Oyo performed better than households in Kano is in the women status and empowerment indicators assessed. For instance, though women in Kano earned more milk money than women in Oyo, they are unable to use this money to buy food for the household because of gender norms in their communities. The use of women's income to purchase better quality and more quantities of food and/or health access is consistently an intermediate variable in the pathway from women's empowerment to improved nutrition (SPRING, 2014; Sraboni et al., 2014). Hence the use of milk money only for women's personal expenses appears to be a crucial limiting factor for nutrition in Kano. This finding suggests that not only is women's empowerment a pathway for agriculture to improve nutrition, as is more popularly established in literature (Ruel et al, 2013); it is also a mediator between other pathways and nutrition, as is increasingly recognized in recent studies (Malapit et al., 2015; IFAD, 2018).

5. RECOMMENDATIONS

Based on the findings of the study, the interpretations of these findings using existing literature, insights from the gender study and general principles for nutrition-sensitive agriculture (FAO, 2015b), the following recommendations are proffered for improving nutrition outcomes of smallholder dairy households in Nigeria. For each recommendation, the suggested interventions, as well as the rationale and proposed implementers, are highlighted.

Recommendation 1: Provide Support around Food Production

Dairy households need to be supported to increase their food production and productivity, to diversify crops cultivated; and to provide adequate postharvest handling to improve year-round food access and affordability.

Suggested Interventions:

a. Increased production and productivity of food commodities

Relevant interventions include working with the states and local communities to improve dairy farmers' access to land ownership/rental for cultivation, while managing the needs and sensitivities of host communities to minimize the occurrence of backlash; providing training & extension services around good agronomic practices; as well as increasing farmers' access to quality inputs in order to increase their yields.

b. Diversification of food production

This intervention targets increasing the production diversity of the households in order to increase dietary diversity at the population level. Fresh green leafy vegetables, animal source foods and intercropping of cereals with legumes can be prioritized for diversification activities. Households can be supported to shift from conventional to biofortified varieties of crops grown. Poultry production can also be prioritized to promote the consumption of eggs, since they are generally acceptable, nutritious but poorly consumed.

c. Adequate postharvest handling to ensure year-round food affordability

Support for adequate postharvest handling needs to go together with support for increased production to support year-round food access and affordability as well as to encourage nutritious diets during migration. Postharvest handling interventions can include increasing access to mechanical dryers by providing them to women cooperatives, such as those recommended by the NDDP gender study. Interventions should also include training and practical demonstrations on optimal postharvest handling of different foods.

Proposed Implementers: LGA Department of Agriculture, State Agriculture Development Programme (SADP), Development Partners

Recommendation 2: Livelihood and Productivity Improvement Support for Households

Various interventions should be implemented as part of broader women empowerment actions so that women are able to increase their income and use it to improve their

households' nutrition systems. . Moreover, the interventions must be properly designed and managed, so that there are no trade-offs in reduced time for women to care for children and their households and themselves. They should also be supported by nutrition education to ensure part of the additional income generated is allocated to diversifying the households' food baskets. Dairy cooperatives/associations suggested in the gender study can be used to support these interventions. It is also important for women to keep control of the income generated through these activities e.g., by increasing their ownership and access to bank accounts.

Suggested Interventions:

a. Veterinary and extension services as well as access to feed & fodder and water to improve animal health and increase milk yields

   Veterinary and animal extension services should be provided to reduce cattle diseases and other cattle challenges, thereby increasing the value of the animals and the income made from them and their milk. Services such as training and extension provided as part of NDDP can be expanded to include vet services that can be provided for a fee through farmers' cooperatives and associations by state and/or private vets and extension officers, thereby developing a support industry. Access to feed & fodder and water should be also improved to increase cattle's productivity.

b. Provision of milk equipment, technologies and training

   Dairy farmers need to be provided with adequate processing technologies, and equipment for increased efficiencies in milk processing and improved milk quality. Dairy processors may work with farmers' cooperatives and associations through grants or loans. This intervention should be targeted at women since they perform the bulk of milk-related activities. Support can be provided around the acquisition of milking equipment, micro cold storage units etc.

c. Enhanced market access for sale of milk products

   Market access is an important link between improved milk production and increased incomes. Smallholder dairy farmers' associations and cooperatives should be strengthened to enable them to more effectively negotiate mutually advantageous partnerships and prices with the dairy processors.

d. Income diversification

   The cooperatives can be used to provide vocational training, promote communal ownership, raising and sale of small livestock and support other activities to help women generate additional income for their household needs. Consumption of the livestock and/or its by-products such as eggs can be encouraged to support the nutritional needs of the household

Proposed Implementers: LGA Department of Agriculture, SADP, Extension Officers, Vets, Development Partners, Dairy processors, Financial Institutions

Recommendation 3: Water, Sanitation and Hygiene (WASH) Support

WASH support interventions are needed as they affect human and cattle health as well as their productivity. They are therefore part of food system approaches to improve nutrition. The communities will need to be engaged to contribute financially and to

manage WASH facilities to ensure their sustainability. A robust behaviour change education and communication campaign is needed and must be targeted at both men and women to drive actual change in improved hygiene practices and in the use of WASH facilities.

Suggested Interventions:

a. Construction of pit latrines and toilets. Considerations around water source and sewer disposal need to be thought through during the design to ensure sustainability.
b. Construction of boreholes, tube wells, covered wells, and/or rainwater harvesting systems
c. Establishment of water resources management systems to ensure sufficient and safe water for human and animal needs
d. Community mobilization, education, and behaviour change communication to facilitate/enhance the use of toilets and water management system; as well as the adoption of hygiene practices.

Proposed Implementers: Rural Water Supply and Sanitation Agency (RUWASSA), LGA WASH Units, Community WASH Committees, LGA Department of Agriculture, SADP, Development Partners, Civil Society Organizations, Dairy processors

Recommendation 4: Nutrition Education, Behaviour Change Communication (BCC), and Social Marketing

Nutrition education is critical and should be provided as it mediates between all other interventions and improved nutrition. Education must focus on increasing both declarative knowledge – awareness of things, and procedural knowledge – knowing how to do things. In other words, households must not only gain knowledge about the meaning of adequate nutrition, including dietary diversity, they must also gain the knowledge necessary to use nutrition information e.g. how to prepare meals incorporating different food groups. Nutrition education, behaviour change communication (BCC), and social marketing must be targeted at both men and women, given the role both genders play in food decisions. Appropriate and adequate provision of the nutrition education, BCC and social marketing will first require sufficient capacity building of extension agents (e.g., from agriculture and health ministries) who will provide related services. Such capacity can be built by harnessing existing nutrition training materials and tailoring them to the capacity needs of relevant staff.

Suggested Interventions:

a. Integrate nutrition education into all platforms through which contact with dairy households is made

   Nutrition education should use food-based dietary guidelines and include messages about the importance of adequate nutrition to health and productivity, as well as food safety and hygiene. Messages used must be contextually and language appropriate and be delivered through appropriate mediums e.g., extension officers, CHEWs, radio, cooperatives, etc.

b. Identify barriers that limit household ability to adopt nutrition education messages

   Additional studies can be conducted to further assess and address barriers other than the limited influence of women (food preparers) in food purchases and over

choice of foods prepared, have on adopting nutrition messages, if only the women are aware of the messages.).

c. Food demonstration and skill building sessions

Activities that develop the self-efficacy of households to adopt adequate nutrition messages, and promote BCC, should be undertaken. These activities should focus on providing practical guidance for addressing contextual barriers to adoption of nutrition education messages. The activities can include meal planning exercises, food demonstrations, and demonstrations of food preparation methods that help preserve nutrients in foods.

d. Social marketing and mobilization

Given the influence that culture and tradition play in the food system and nutrition of the studied households, it is important that activities be undertaken to influence community culture and norms around food choices and perceptions of adequate nutrition. Tailored messages may be needed for each gender for increased effectiveness and to sustain nutrition behaviour changes in the households.

Proposed Implementers: LGA Departments of Agriculture and Health, SADP, State Ministries of Health, Development Partners (including Food and Agriculture Organization of the United nations and other Partners)

6. CONCLUSION

Malnutrition is a considerable challenge among smallholder dairy producers in Oyo and Kano.

There is a serious underweight prevalence among women in both states, and a critical prevalence of acute malnutrition among young children in Kano. The overweight/obesity situation in Kano is also high and a cause for concern. Although Kano households have better access to resources for food than those in Oyo, health, and care, health service utilization, access to nutritious foods, and dietary intake is equally inadequate.

The findings also suggest that there are seasonal variations in food availability and access; and that even the insufficient access observed is likely to be a best-case scenario as the study was conducted during harvest, when food is more bountiful in both states.

In addition, the study showcases the important role that men play in food purchase and consumption, particularly in Kano. Women's control over food resources and involvement in food decisions seem to be very critical for improving nutrition since opportunities and ability to use nutrition education are important for translating knowledge into improved practices.

The own consumption, market/prices, and the women's empowerment pathways appear to be the most important pathways for improving nutrition within the context of the study population. The right mix of interventions for improving nutrition need to include increased food production, income, and nutrition education and WASH support. The state agriculture and health departments, development partners and the dairy processors all have have a critical role to play in addressing challenges and constraints around nutrition and health.

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