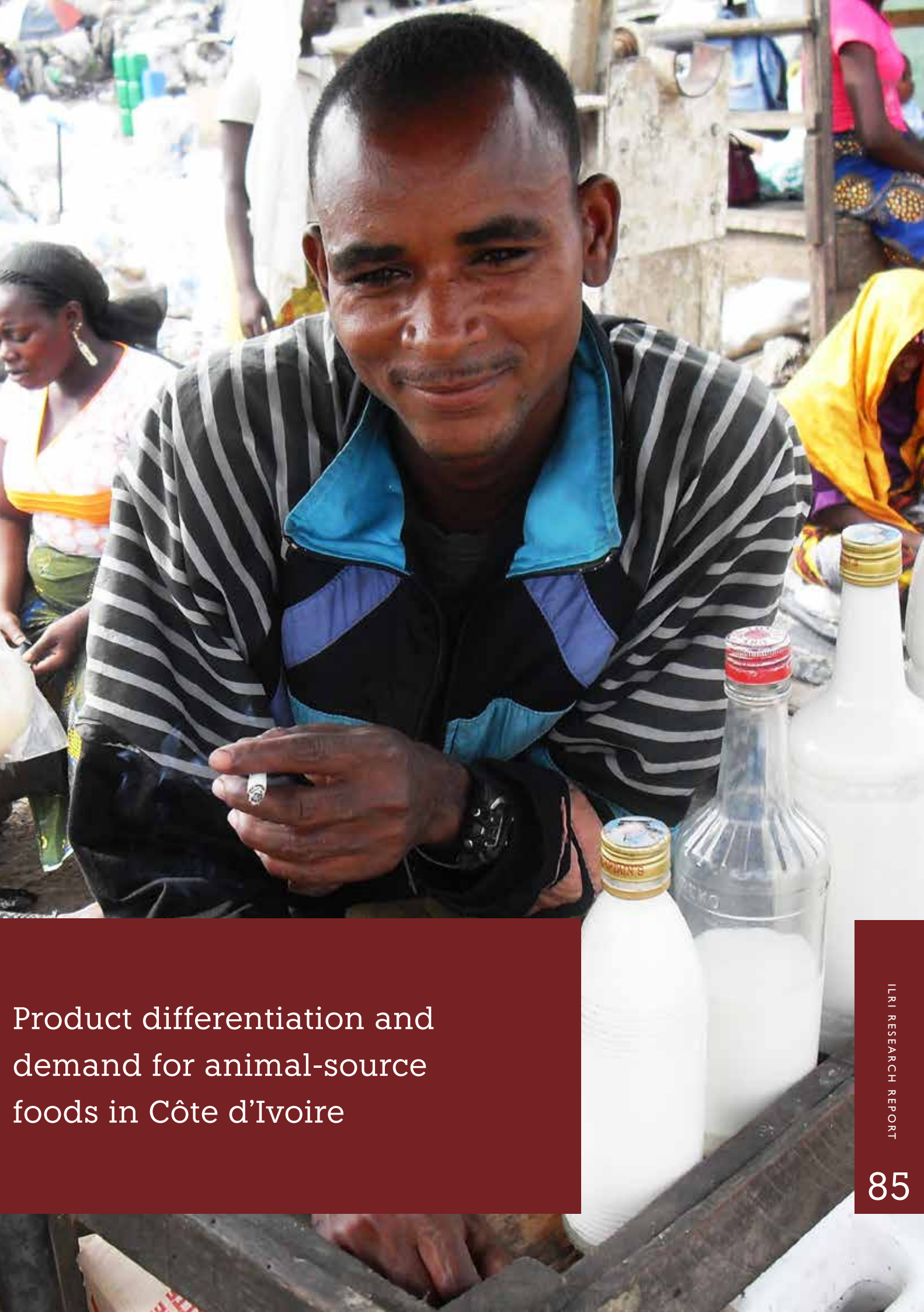

Product differentiation and demand for animal-source foods in Côte d'Ivoire

Product differentiation and demand for animal-source foods in Côte d'Ivoire

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December 2021

ILRI thanks all donors and organizations which globally supports its work through their contributions to the CGIAR Trust Fund

Editing, design and layout—ILRI Editorial and Publishing Services, Addis Ababa, Ethiopia.

Cover photo—ILRI/Sylvie Mireille Kouamé-Sina

ISBN: 92–9146–683–8

Citation: Wane, A., Rich, K.M., Bamba, Y., N'Goran, A.A. and Fall, A. 2021. *Product differentiation and demand for animal-source foods in Côte d'Ivoire*. ILRI Research Report 85. Nairobi, Kenya: ILRI.

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Acknowledgments

This study was funded by the CGIAR Research Program on Policies, Institutions and Markets (PIM), which is led by the International Food Policy Research Institute (IFPRI). The authors gratefully acknowledge funding support from the CGIAR Research Program on Livestock (CRP Livestock), and the contributions of officials from the Ministry of Animal and Fisheries Resources (MIRAH) and the Bureau National d'Études Techniques et de Développement (BNETD) in Côte d'Ivoire.

We are thankful to all respondents for their participation. Dolapo Enahoro (International Livestock Research Institute) provided useful comments and edits. This report has not gone through the standard peer review procedures of ILRI, CIRAD or IFPRI. The authors accept full responsibility for all content, opinions, errors, and omissions in the report.

Acronyms and abbreviations

ASF	animal-source food
AIDS	Almost Ideal Demand System
BNETD	Bureau National d'Études Techniques et de Développement
LES	Linear Expenditure System
MIRAH	Ministry of Animal and Fisheries Resources
ODK	Open Data Kit
QUAIDS	Quadratic Almost Ideal Demand System

Summary

This report presents a demand analysis of primary data collected from 562 households in Abidjan, Côte d'Ivoire. Findings show that Ivorian consumers purchase animal-source food more from traditional retailers where source-differentiated foods are sold in simple or primary forms. There is, however, an emergence of local and international retail brands (modern butcheries, supermarkets) trading in more specialized or processed animal food products. Consumers are generally sensitive to expenditure variation in their demand for chicken and fish. The expenditure elasticities of chicken and fish were found to be significant and positive. The elasticity of fish was estimated greater than one while that of chicken was slightly lower (0.96), indicating fish as a superior good in the households surveyed. The expenditure elasticity of beef was not significant meaning that the increase in expenditure has no effect on the demand for beef.

1 Introduction

In sub-Saharan Africa, where access to food is marked by random supply, efficiency gaps, productivity losses and food insecurity, there has been a clear tendency for livestock sector interventions to focus on enhancing production systems and thus support the supply of livestock products. These approaches are justified. However, value chain analysis show that African countries are strongly constrained by the persistence of a relatively low offtake rate of livestock production systems (8-12%) despite many interventions to stimulate offtake. Simulation exercises implemented by Rich and Wane (2021) and Wane and Rich (2019) have preliminarily shown that an improvement in animal and herd productivity as well as a development of diversified, alternative, and lucrative markets would be more effective in increasing value chain performances rather than a hypothetical and exhausting increase in herd offtake rates. Then, sector analyses that often focus on supply-side constraints can be usefully combined by end-market analyses to better capture emerging opportunities and threats to inform the decision-making process for effective sectoral development. Therefore, connecting supply and demand of animal-source foods (ASF) products is critical both at the national and regional levels.

Few studies have been carried out on household ASF demand in Côte d'Ivoire. This report focuses on the meat demand patterns in Abidjan as the main end-market in Côte d'Ivoire for cattle imported from Sahelian countries (Mali, Burkina Faso and Niger). Although there have been numerous debates over the cause and nature of structural shifts in the parameters of beef demand, the presence of diverse animal-source foods and the diversification of supplies intensifies the need for further study of the meat consumption patterns in Côte d'Ivoire. Despite its high importance, analysis of the drivers of regional trade in cattle, in particular from Mali, has been relatively neglected by most trade analysts in West Africa. Magnitudes and volumes of exchanges observed between Mali and Côte d'Ivoire make it relevant to analyse this form of economic interconnectivity, focusing on cattle and beef demand in Côte d'Ivoire to provide insights about how this end-market can play a critical role in the livestock sector in Mali, for example.

This study used primary data collected from 562 households in Abidjan's main end-market to examine the response of aggregate ASF demand to variations in price and expenditure. Although pork and wild meats are popular in Côte d'Ivoire, the focus in this study was on animal-source foods that are more likely to (1) be consumed by all regardless of their religious beliefs (i.e. ruminants, chicken and fish) and (2) have potential impact on the regional livestock trade. We analysed meat demand using three forms of Almost Ideal Demand System (AIDS) models (linear, demographic and quadratic) applied to ASF (ruminant, chicken, and fish) consumption preferences. A demographic approach was applied to the analysis of demand for beef cuts (meat and offal) as well as chicken and fish.

The report is organized as follows: Section 2 briefly introduces the theoretical foundations of the AIDS models commonly used for demand analysis, and the estimation procedure; Section 3 provides the data sources and research methodology; Section 4 presents and discusses the results and the conclusion is given in Section 5.

2 Theoretical foundations and estimation procedure

Demand analyses often use partial equilibrium models. These models focus on the levels of demand for current consumer goods by an individual, household or producer, based on the structure of current relative prices, real income, and a set of individual characteristics. Household consumption behaviour has always been of major interest to economists and has made important research and development contributions that deserve to be critically analysed. In terms of consumer theory, a good specification of consumer behaviour requires considering both relative incomes and prices. Since Engel's seminal work (1857, pp. 28-29) revealing that 'the higher the income, the lower the share of income allocated to food expenditure', more contemporary contributions have verified and even shown what the economic literature calls Engel's law (Houthakker 1957; Seale and Regmi 2006; Lewbel 2008). However, the beginnings of economic modelling applied to demand systems in consumer theory are associated with the work of Stone (1954). Subsequently, other more specific or functional approaches emerged, notably with Deaton and Muellbauer (1980) whose Almost Ideal Demand System (AIDS) model provides a very popular empirical analytical tool in many countries (Alem 2011). The most significant contributions to provide demand analysis are the model of Rotterdam (Theil 1965), Translog model (Christensen et al. 1975), Armington (1969) and the AIDS that is a consumer demand model used to study consumer behaviour (Deaton and Muellbauer 1980).

The analysis of demand systems has known a rapid theoretical and empirical development in recent decades. Studies have developed the AIDS model using panel data, which leads to convergent estimators with the increase in the number of observations. This approach also makes it possible to take account of consumption behaviour through its individual and temporal dimensions and to highlight the influence of individual and aggregate factors on this behaviour (Sevestre 2002). Other studies have attempted to work with households organized into subgroups that are homogeneous in terms of household size (Banks et al. 1997; Calvet and Comon 2000; Khed 2018). However, as Deaton and Muellbauer (1980) pointed out, the criterion of homogeneity depends not only on household size but also on household composition. Indeed, two households with the same number of individuals but composed differently certainly do not have the same demand for food. Moreover, demand can also depend on consumption habits (Calvet and Comon 2000), so that there is an inelasticity of demand for certain goods, which are often considered non-priority in certain situations. Indeed, a household can be satisfied with the same quantity of products demanded regardless of its size and composition. Banks et al. (1997) have amply demonstrated the relativity of the notion of income elasticity.

As with most consumer goods, AIDS approaches and their variants have been applied to the meat sector. In sub-Saharan Africa, many studies have applied variants of AIDS approaches to analyse meat demand/consumption in middle-income countries (e.g. Ojogho and Eqware 2015; Shibia, Rahman and Chidmi 2017). However, it should be noted from the outset that the application of AIDS approaches must take account certain specificities such as the lack of statistical data, the dual nature of economies, the limited opportunity for substitution between broad categories of goods, the distortion created by market subsidies, and the possible primacy of demographic variables over other standard variables such as prices and income (Goaïed 1991). For all these reasons, it is strongly recommended to use the AIDS approach developed by Deaton and Muellbauer (1980) while integrating demographic aspects.

The AIDS model was implemented for the case of Abidjan using a three-step estimation procedure (not shown) in which (1) households allocate expenditure between several categories of goods and services, (2) expenditure on food includes the purchase of ASF, and (3) expenditure on ASF is allocated to the purchases of beef, mutton, goat meat, pork, bush meat, poultry, fish and shellfish.

3 Data sources and quantitative research methodology

3.1 Secondary data

This study used secondary data collected from various sources. The viewpoints of officials from the Ministry of Animal and Fisheries Resources (MIRAH) in Côte d'Ivoire were collected through in-depth interviews. A meeting organized on 28 March 2019, on the premises of the ministry, allowed the authors to share the research design, discuss sector policies with decision makers, and gather additional data on the livestock sector. The research team also met on 22 May 2019, with experts from the Bureau National d'Études Techniques et de Développement (BNETD), a centre of expertise for global and sectoral strategy and development that supports the Ivoirian government in the implementation of large-scale development projects including in the livestock sector. These meetings facilitated the gathering of relevant information on the livestock and meat supply chain in the country. Finally, we triangulate information on cattle and beef trade by using International Trade Statistics and Import/Export Data (UN Comtrade, 2019; FAOSTAT, 2019).

3.2 Primary data

To answer the question on the current consumption patterns of ASF and beef cuts in Abidjan, primary quantitative data were collected and used. The viewpoints of the consumers were collected through in-depth interviews of respondents randomly distributed within the 10 communes of the district of Abidjan. The data collection work was based on one survey conducted between March and May 2019 on 562 households in the city of Abidjan, the main meat end-market in Cote d'Ivoire, as an administrative entity composed of two parts (Abidjan north and Abidjan south) and 10 communes on either shore of the Ebrié lagoon. Out of a sample of 562 households, the largest number of respondents resided in the populous commune of Yopougon where 171 households were interviewed (31% of the sample) while the smallest was in the commune of Plateau; a commune housing many office buildings (1% of the sample).

The data collection tool was built on semi-structured questionnaires related to respondents' socio-demographic characteristics, purchase of ASF and consumption habits, beef purchase and consumption habits as well as offal purchase and consumption habits. The questionnaire included general questions related to the proportion of monthly expenditure used for family food, purchase of meat and cuts, monthly expenditure on food and non-food items. Given the heterogeneous distribution, the AIDS analysis of ASF demand in Abidjan focused on the most consumed products declared by the respondents specifically cattle meat (consumed by 97% of the sample), chicken meat (89%) and fish (88%).

The first level of data elucidation identified the main sources of animal proteins (excluding pork and wild meat). In a second level, beef demand was disaggregated by beef products of different cuts.

The survey tool was designed on Open Data Kit (ODK) and transferred to Android tablets for electronic capture. In each commune, field enumerators were recruited and trained to administer the questionnaires. The team leader of the field activities oversaw data cleaning and quality assurance every day after the enumerators returned from the field. Data was then uploaded to the server and downloaded in Excel and statistical files for further cleaning. Analysis was mostly done using Stata software.

4 Results and discussions

4.1 Allocation of household expenditure

The demand level for food and non-food consumption varied in accordance with the socio-economic characteristics of the study households. Overall, households were found to allocate 40% of their expenditure to food purchases.

4.2 Findings from secondary data

The meat consumed in Côte d'Ivoire comes from national production, imports of live cattle from Sahelian countries (Mali, Burkina Faso, Niger) and frozen meat from Asia, Latin America and Europe. Côte d'Ivoire imports the bulk of its meat from cattle and small ruminants, some of which originates from live animal imports from the Sahelian countries. According to the United Nations database UN Comtrade (2019), three categories of frozen beef are imported into Côte d'Ivoire: carcasses, frozen meat cuts with bone (excluding carcasses and half-carcasses), and frozen boneless meat. According to the published data, imports of frozen meat declined from 1,539 tons in 2014 to 408 tons in 2017. The decrease was more pronounced for frozen bone-in cut meat (except for carcasses and half carcasses). The country also imported fresh or chilled beef following broadly the same trends as frozen meat for the period from 2014 (26.8 tons) to 2017 (22.7 tons).

4.3 Socio-demographic analysis

Small-size households (with less than five people) are relatively important in our sample (33%), while large-size households (with nine or more people) account for nearly one-fifth of the households surveyed (19%). Most of the households surveyed had between five and eight family members. Almost all heads of households were male (88%). Females interviewed accounted for almost one in nine (13%). The structure of the population by major age groups was characterized by a significant proportion of the number of people aged between 21 and 50 years (89%) as active household respondents, with a dominance in this category of the 31-40 years-old age group (46%). As might be expected, very few respondents were under 20 years old (1%) or over 60 years old (2%). For the level of education of the active head of household surveyed, we simplified by considering five categories: those who have no formal education in the official language (French), those who have reached primary, secondary and university levels and those who report other forms of education. The level of education of the household heads surveyed is relatively average, with 52% having at least a secondary level. Some of them (23%) reported having attained a higher or university level, while 24% reported a primary level of education. It should be noted that 24% of the respondents declared that they had not received formal education in French. Most of the heads of households interviewed were married (63%). It also emerged that a small proportion of the heads of households interviewed were not of Ivorian nationality (11%) and 11% of respondents indicated not having a job. The majority (46%) reported being farmers and workers, 14% were self-employed and 28% were executives (Table 1).

Table 1. Summary statistics of qualitative variables included in the analysis

Parameters	Description	N	Frequency per category	Relative frequency (%)
Gender of interviewee	0=male	562	488	87
	1=female		74	13
Age	1=under 20 years old	562	8	1
	2=21 - 30 years old		137	24
	3=31 - 40 years old		259	46
	4=41 - 50 years old		105	19
	5=51 - 60 years old		39	7
	6=over 60 years old		14	2
Education	0=other	562	136	24
	1=primary		136	24
	2=secondary		159	29
	3=university		131	23
Marital status	0=other	562	208	37
	1=married		354	63
Citizenship	0=other	562	62	11
	1=Ivoirian		500	89
Profession	0=no employment	562	72	13
	1=farmers & workers		257	46
	2=independents		76	14
	3=executives		157	28

4.4 Descriptive statistics on ASF consumption

Table 2 summarizes other fitted variables of the AIDS model. These variables are related to consumption frequencies, quantities, prices, and purchases of all ASF categories. Prices were generated while other variables were collected through intensive one-on-one interviews with 562 household respondents. It should be mentioned that there are some missing data so that the basis of analysis differs depending on the commodities and variables targeted. On average, the price of beef, chicken, fish and offal is XOF2,300; 3,100; 1,800 and 1,825, respectively. However, depending on the place of purchase (markets, supermarkets, rotisseries, etc.), prices can vary greatly, as illustrated by the standard deviation values.

Table 2. Statistics summary of fitted quantitative variables

Variables	Description	N	Minimum	Maximum	Mean	Standard deviation	Standard error
HH size		562	1	55	6	4	0
Expenditure (XOF)	Beef	288	500	36,500	4,358	5,215	307
	Offal	504	300	78,000	7,421	9,445	421
	Chicken	498	500	60,000	6,319	7,824	351
	Fish	492	100	60,000	2,856	5,818	262
Prices (XOF)	Beef	287	2,000	3,500	2,329	191	11
	Offal	471	500	5,230	1,825	409	19
	Chicken	496	1,750	12,500	3,203	944	42
	Fish	489	165	4,000	1,779	226	10
Monthly expenditure (XOF)	Food	550	15,000	750,000	87,069	56,020	2,389
	Non-food	530	5,000	700,000	125,803	92,251	4,007
	Total	528	15,000	1,160,000	213,798	122,131	5,315

(a) West African CFA franc – XOF (Exchange rate in April 2019 was 1 USD = XOF 579.59).

Source: Authors' computation from field survey, 2019.

Econometric estimates

For all ASF, three AIDS models were tested to determine the most appropriate model with respect to estimating the elasticities:

- a Linear Expenditure System (LES) as a reference model that is a demand system in expenditure relative to price, which often fulfils the regularity conditions of demand theory;
- a demographic version of the Almost Ideal Demand System (AIDS) that fits consumer expenditure theory and provides new insights relative to that provided by the traditional single equation approach;
- a demographic version of the Quadratic Almost Ideal Demand System (QUAIDS) as an extension of the demographic version of the AIDS to overcome the limitation of the flexibility in expenditure.

The two demographic models with and without a quadratic term produced near-identical estimates except that the model with quadratic term had a higher value of log-livelihood. For parsimony, only the QUAIDS is presented below in contrast with the LES.

4.5 Demand for ASF

The header of Table 3 indicates the type of model fit, the number of observations and demographic variables, the value of alpha_0 used, and the maximized value of the log-likelihood function. The table of estimated parameters is divided into groups representing each vector or matrix that appears in the demand system.

According to Table 3, all autonomous values of the budget coefficients represented by α () in each equation are significant at level 1% whatever the model used. Moreover, in the absence of expenditure and price variations, expenditure on beef represents 32% of total expenditure in the linear model but stabilizes at 27% in the demographic model and the demographic model with the quadratic term; expenditure on fish represents 29% in the linear model and stabilizes at 34% in the other models; expenditure on chicken remains almost stable at 39% regardless of the model considered.

An income variation may lead to a significant and negative variation at 1% in demand for chicken and a significant and positive variation at 1% in demand for fish in the linear model. However, with the introduction of demographic parameters, only the variation in the demand for fish remains significant and positive at 5%.

Cross-term analysis indicates that all three coefficients are still significant while keeping the same signs. The results are very close to the former for both the cross-terms and the direct price effects.

Table 3. Demand for ASF

Linear Expenditure System (LES)		Demographic QAIDS	
Number of observations	=445	Number of observations	=445
Number of demographics	=0	Number of demographics	=1
Alpha_0	=0	Alpha_0	=0
Log-likelihood	=1089	Log-likelihood	=1110
Variables	Coefficient	Variables	Coefficient
Alpharc		Alpharc	
	0.32***		0.275***
	0.39 ***		0.386***
	0.29***		0.340***
Betarc		Betarc	
	-0.00		0.051
	-.018***		-0.019
	0.021***		0.032**

Variables	Coefficient	Variables	Coefficient
Gammarc		Gammarc	
	0.111***		0.109***
	0.045***		0.045***
	-0.157***		-0.154***
	-0.169***		-0.170***
	0.125***		0.124***
	0.032**		0.030**
		Lambdarc	
			-0.010
			-0.002
			0.012***
		Etarc	
			-0.001
			0.001**
			-0.000
		Rhorc	
			0.026

Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1
Source: Authors' computation from field survey, 2019.

Moreover, the demographic variable represented by the Eta parameter, which reflects the effect of household size on their demand for meat and fish, is significant only for chicken demand meaning that demand for beef and fish is neutral to the household size that, however, positively influences the demand for chicken.

With the quadratic term, only the lambda coefficient for fish is significant. When expenditure reaches a very high level, its variation positively impacts the demand for fish only.

Determining price and expenditure elasticities is central to the development of the AIDS model. To do so, we applied a technical adjustment to avoid the overvaluation of elasticities in particular for households that do not declare consuming a particular good (budget coefficient close to 0). Zero observations are commonly found in consumption and expenditure data and should be excluded in demand system analysis. Therefore, we removed from the analysis households with coefficients equal to 0, leaving a sample of 202 observations out of an initial 445. Despite the loss in precision, the approach yields useful elasticities. Model results on expenditure and price elasticities are summarized following.

The expenditure elasticities of chicken and fish were found to be significant and positive. The elasticity of fish was estimated to be 1.19, since this is greater than 1, fish will be considered a superior good in the households surveyed. The expenditure elasticity of beef was estimated at 1.01 but was not significant. With expenditure increases of 1%, the demand for chicken was found to increase by 0.96% while the demand for fish increased by 1.2%. The expenditure elasticity of beef is positive but not significant, meaning that the increase in expenditure has no effect on the demand for beef.

The (compensated) price elasticities are similarly reported. All direct price elasticities were found to be negative, meaning that all goods followed the pattern for normal goods. A 1% increase in beef price in the model leads to a 0.33% decrease in beef demand. This result confirms the descriptive analysis, which shows that 63% of households wish to reduce their consumption of beef following a price increase. On the other hand, a 1% beef price increase causes a 0.63% increase in chicken demand. Chicken meat and beef meat are thus found to be substitutable as mentioned above. In addition, a 1% increase in beef price leads to a 0.29% decrease in fish demand, indicating beef and fish could be substitutable goods.

Results from the demand analysis of specific meat cuts indicated cuts are responsive to expenditure variation assuming ceteris paribus. The expenditure-related coefficients were significant in all demand equations, meaning that changes in expenditure lead to changes in the demand for beef, offal, chicken and fish. An expenditure increase causes an increase in offal and fish demands so that they can be considered as normal goods. While beef and chicken responded negatively to expenditure changes (i.e. characterizing them as inferior goods), expenditure elasticities were positive for all products, indicating them as normal goods (contrary to the results of the AIDS model).

5 Conclusion

The objective of this paper was to provide an empirical exploration of Ivorian households' demand reactions to price and expenditure variations for ASF and meat cuts through the specification and estimation of comparable demand models. From primary data collected between March and May 2019 on 562 households in the 10 communes of Abidjan, the capital city of Côte d'Ivoire and the main meat end-market, price and expenditure elasticities for ASF (cattle, chicken and fish) as well as for specific cuts (beef, chicken and fish meat and beef offal).

For ASF and beef cuts, the demographic AIDS model, compared to linear and quadratic models, proved to be more relevant in analyzing households' demands.

Some shortcomings of the analysis are worth mentioning. First, to circumvent the problem of zero purchases, the aggregation of purchases for each commodity might have led to some loss of information. Second, our study focused on the most consumed meats as reported by respondents, so there were few responses regarding pork. The lack of declarations concerning pork may be due to religious reasons with the presence of a large Muslim community, estimated at 43% of the population in Côte d'Ivoire. However, by excluding pork, some substitution effects may be misjudged. Many factors, in addition to price and expenditure, can influence decisions to consume meat. Third, for methodological convenience, the sustainability of consumption patterns has not been addressed in this report, even though the sustainability of food systems is a major food security and economic policy issue. Therefore, future studies could provide more information by estimating the parameter of sustainability in a demand system.

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92–9146–683–8

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