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Evaluation of the Economic Profitability of the Mangosteen (*Garcinia mangostana*) Trade in Côte d'Ivoire: Survey of Six Markets in the Autonomous District of Abidjan

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Abstract: Côte d'Ivoire's fruit and vegetable exports are literally dominated by pineapple, banana and mango. Apart from these fruits, Côte d'Ivoire also exports some fruits that do not enjoy the same success as their congeners, including the mangosteen (*Garcinia mangostana*). The objective of this study was to evaluate the microeconomic profitability of the mangosteen trade in Côte d'Ivoire through the socio-demographic characterization of the traders, the analysis of the marketing circuit, the evaluation of the financial profitability of the trade and the determination of the constraints encountered in the exercise of the activity. To do this, a reasoned choice survey was used as a method for collecting information on mangosteen marketing. The survey was conducted among retailers in five markets in the city of Abidjan and in the fruit market in the town of Azaguié. The results reveal that the mangosteen trade is exclusively carried out by women, most of whom are from the north of Côte d'Ivoire. This activity generates an average monthly income of 110,376.66 ± 2,734.16 CFA francs, which enables traders to meet several expenses. The average financial returns obtained on each of the markets surveyed were above 10%. The average financial return was 81.16%. The marketing of the mangosteen could therefore constitute a real opportunity for economic and social development for the population, which deserves a lot of attention.

Keywords: Mangosteen, Average Financial, Marketing, *Garcinia mangostana*, Côte d'Ivoire

1. Introduction

In Côte d'Ivoire, the fruit and vegetable sector plays a very important economic role through the foreign currency it generates. This sector alone generates more than $400 million per year for the Ivorian state, making it the fifth largest provider of foreign currency [1]. Ivorian exports in this sector are literally dominated by pineapple, banana and mango. An average of 200,000 t of bananas, 35,000 t of pineapples and 150,000 t of mangoes are exported annually, mainly to the European Union [2]. Apart from these fruits, Côte d'Ivoire also exports certain fruits which, however, do not enjoy the same success as their congeners, including the mangosteen.

The mangosteen tree (*Garcinia mangostana* L.) is a tropical fruit tree of the Clusiaceae family produced for the highly appreciated taste of its fruit and its excellent medicinal properties. The mangosteen was introduced to Côte d'Ivoire in 1970 through the fruit programme of the Institut de Recherche Fruitières d'Azaguié (IRFA) [3]. Since then, this fruit has remained inaccessible and unknown to the general public because it has

benefited from very few studies, whereas the development of the mangosteen could enable the actors of the fruit sector and the Ivorian economy to benefit fully from it [4]. According to Fowler [5], the analysis of profitability is of major interest because the break-even point is a decision factor for the launch or withdrawal of a product on the market and therefore for its promotion.

In such a context, it would be wise to undertake studies in this area in order to contribute to the development of the mangosteen. The present study therefore aims to evaluate the economic profitability of the mangosteen trade in Côte d'Ivoire. Specifically, it will first characterise the traders, analyse the marketing circuit, evaluate the economic profitability of the trade and determine the difficulties encountered in the exercise of the activity.

2. Materials and Methods

2.1. Markets Surveyed

The study required surveys to collect information from actors involved in the mangosteen trade. These surveys were carried out on five markets in the communes of the city of Abidjan and on the fruit market in the commune of Azaguié. The markets in the city of Abidjan targeted were the Adjamé wholesale market (Adjamé Gouro market), the Yopougon wholesale market (Yopougon Siporex Gouro market), the Plateau commune fruit market (marine base fruit market), the main market in Abobo (town hall) and the main market in Anyama. As for the commune of Azaguié, the fruit market of the said commune (Carrefour de la Paix market) was chosen for the study. The choice of these markets is justified by the fact that they are home to a large number of fruit traders and are the main sources of supply for secondary markets.

2.2. Pre-survey

A preliminary survey phase was necessary to carry out this study. This phase allowed us to better frame the questionnaire and to acquire a better knowledge of the field. Markets were visited for this purpose in order to identify those where a significant number of mangosteen traders could be found. Exchanges with some stakeholders provided information on the activity in an informal manner. In addition, this phase made it possible to define the number of people to be surveyed and to adopt an appropriate approach for the survey. The number of people surveyed (*n*) was defined using the Faulkenberry and Daly formula (1) [6], which includes a constant (*Za* = 1.96), the estimated percentage of female mangosteen traders per market (*p*) and a margin of error (*i* = 0.08).

$$n = \frac{(Za)^2 \times p(1-9)}{i^2} \qquad (1)$$

2.3. Survey Method

A repeated-pass survey based on a reasoned choice survey was used as a method of collecting information from traders. This type of survey makes it possible to carry out studies on a part of the population that has the same characteristics or carries out the same activities for which the results obtained can be extrapolated to the whole population [7]. The survey was carried out among 120 retailers in all the markets surveyed, with 20 retailers per market. This type of trade was chosen because it is an essential link in the economic life of a country, since it makes products available to consumers wherever they are and whatever means they have [8].

The respondents were first subjected to a structured questionnaire developed from the Sphinx Plus software, and then batches of mangosteen taken at random from their displayed goods were weighed in order to evaluate the price per kilogram (figure 1). The survey was conducted during the two production seasons of May to August (high season) and December to February (low season), from which the survey was repeated. The questionnaire submitted to the respondents made it possible to collect four types of information, namely, socio-demographic characterisation, information relating to the fruit marketing circuit, information making it possible to evaluate the economic performance of the activity and, lastly, information relating to the constraints encountered by traders in carrying out the activity.

Figure 1. Mangosteen fruits on display at the Plateau fruit market.

2.4. Accounting Approach to the Value Chain

An accounting approach was combined with the sample survey to assess the resource costs incurred by women traders in the different markets and the profits earned by them. It consisted in analysing the process of creation and redistribution of added value within the trade. Thus, for each trader surveyed, economic performance indicators were assessed. There are several performance indicators, however, for this study three indicators were assessed: gross margin, net profit and financial profitability [8, 9]. These indicators were calculated monthly for each trader surveyed. In order to determine these indicators, the Average Supply Quantity (ASQ), Average Purchase Price (AP) and Average Selling Price (ASP) per kilogram were determined.

2.4.1. Gross Margin

The Gross Margin (GM) provides an approximation of the profitability of a sales activity. It is an economic theme that relates the difference between Total Revenue (TR) and Operating Expenses (OE) (2).

$$GM = TR - OE \qquad (2)$$

2.4.2. Net Profit

Net Profit (NP) is an indicator that refers to the difference between the gross margin (GM) and the cost price (sum of the expenses necessary for its operation) (RP) for an activity (3). An activity that generates net profits indicates that the gross income earned exceeds the investment [10].

$$NP = GM - RP \qquad (3)$$

2.4.3. Financial Profitability

Financial Profitability (FP) is one of the most important elements for assessing the economic performance of an activity. It reflects the profits generated by a company and the viability of a sector in terms of commercial profitability [8]. This quantity has been determined as the ratio between the Gross Margin (GM) and the cost price (sum of the expenses necessary for its operation) (RP) for an activity (4). When the financial rate of return is around 10%, the activity is considered satisfactory.

$$FP = \frac{GM}{PR} \times 100 \qquad (4)$$

2.5. Statistical Analysis

Sphinx Plus and Xlstat Pro version 7.5 software were used to process the collected data. The analysis of variance (ANOVA) and the Kruskal-Wallis test were used at the 5% significance level to compare the average prices obtained on the different markets. In the event of a significant difference, multiple comparisons of means were carried out using the Tukey test [11]. The chi-square dependence test was used to assess the strength of relationships between variables. Arcsin ($\sqrt{P}$) (p = percentage) transformations were performed for the analysis of percentage values.

3. Result

3.1. Socio-demographic Characterisation of Traders

The results of the socio-demographic characterisation of traders are shown in Table 1. The distribution of traders by gender revealed that the mangosteen trade is conducted exclusively by women (100%). This trade involves almost all age groups. However, the age group most represented in all markets was between 20 and 30 years old (48.33%). It also appears that the mangosteen trade is mainly practised by women from the north of Côte d'Ivoire (55.83%), followed by nationals of the Economic Community of West African States (ECOWAS) (27.5%). The highest numbers of female traders who are ECOWAS nationals were observed in the markets of Yopougon and Anyama. The distribution of traders by level of education indicates that more than half of the female mangosteen traders have never attended school. The proportion of the latter represented 56.66% of the total number of traders surveyed. Those who had started primary school represented 30% of the respondents. The Chi 2 test revealed that the level of education of women traders was not related to the commune. The Kruskal-wallis test revealed a significant difference between the distributions of women traders according to age group, origin and level of education (p < 0.05).
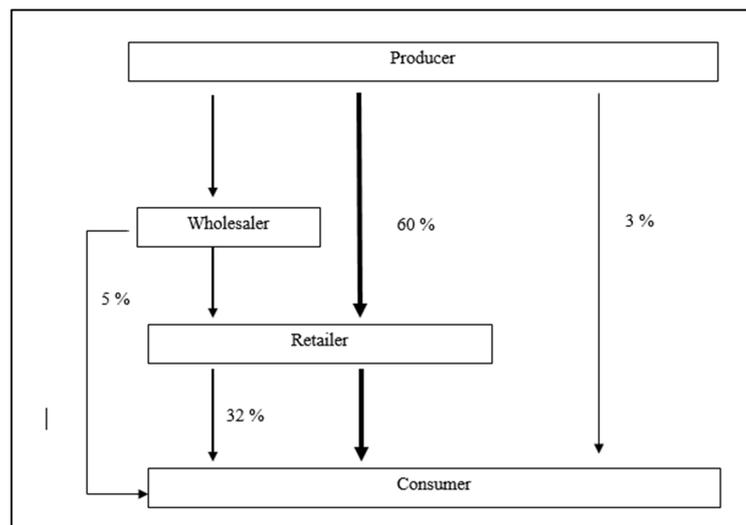

Figure 2. Marketing channel of mangosteen.

3.2. Marketing Channel

The mangosteen marketing circuit is relatively simple. It involves three major actors, namely producers, wholesalers and retailers. Three main channels are used to sell the produce. These channels consist of the short channel, which goes directly from the producer to the consumer, the medium short channel, which goes from the producer to the consumer via the

retailer, and the long channel, which goes from the producer to the consumer via the wholesaler and the retailer (Figure 2). The medium-short channel is the one most used on all markets, accounting for 60% of the channels used by traders. This channel was also used extensively on the Azaguié and Plateau fruit markets. The long channel is also used to transport mangosteen to consumers. The rate of use of this channel is 32%. The short channel, which runs directly from the producer to the consumer, although rare, is little used and accounted for 3% of the rate of use of outlets.

3.3. Assessment of the Financial Profitability of the Mangosteen Trade

The results of the economic profitability of the mangosteen trade are presented in Table 2. These results reveal that the average quantity of supply per trader was 148.83 ± 6.73 kg/week. The average purchase and sale prices were respectively 458.66 ± 60 FCFA/kg and 895.83 ± 103.33 FCFA/kg.

The average monthly gross margin (GM) obtained by the traders was $121,460 \pm 2,650$ FCFA/month. The highest margin was obtained at the Plateau market ($285,290 \pm 2,580$ FCFA) and the lowest at the Anyama market ($99,920$ FCFA). The average net profit for all markets was $110,376.66 \pm 2,734.16$ FCFA. The highest average net profit (NP) was also obtained at the Plateau fruit market ($180,290 \pm 4,280$ FCFA) and the lowest profit was recorded at the Yopougon wholesale market ($71,150 \pm 2,105$ FCFA) (figure 3). As with the gross margin, a significant difference was observed between the averages for net profit ($p < 0.05$).

The mangosteen trade proved to be a profitable activity for the traders, as 97.8% of the respondents stated that the marketing of this fruit is a profitable activity. The financial profitability obtained on each of the markets surveyed was above 10% (threshold value that indicates satisfaction). The average financial profitability of the activity was 81.16%.
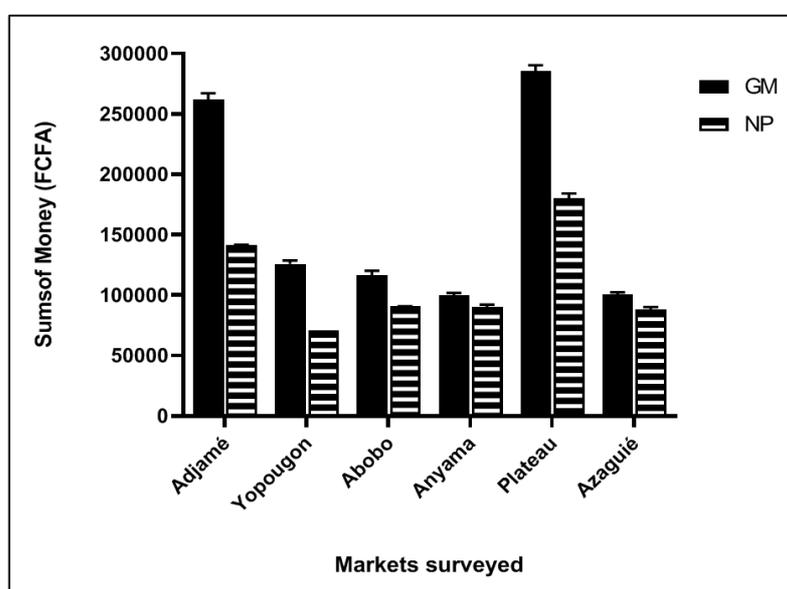

Figure 3. *Gross margin and net profit obtained by market.*

Table 1. *Summary of the socio-demographic characterisation of traders.*

Category	Modality	Adjamé	Yopougon	Abobo	Anyama	Plateau	Azaguié	Percentage (%)	Statistics	
									F	P
Type	Male	0	0	0	0	0	0	0	465.16	≤ 0.001
	Female	20	20	20	20	20	20	100		
Age group	20 - 30	10	8	8	12	8	12	48.33a	21.84	≤ 0.05
	30- 40	8	8	8	6	2	6	31.66a		
	40 - 50	2	4	4	2	10	0	18.33b		
	> 50	-	-	-	-	-	2	1.66c		
Origin	North	14	8	14	11	10	10	55.83a	19.36	≤ 0.05
	South	4	0	8	-	-	8	10b		
	East	2	-	-	-	-	-	1.66c		
	West	-	-	-	-	6	-	5c		
	ECOWAS	-	12	6	9	4	2	27.5b		
Level of study	Illiterate	14	12	13	9	6	14	56.66a	123.41	< 0.001
	Primary	6	6	7	7	8	2	30a		
	Secondary	-	2	-	4	6	2	11.66b		
	Academic	-	-	-	-	-	2	1.66b		

Values with different letters are statistically different at the 5% threshold (Tukey test); $p \leq 0.05$: significant probability; $p \leq 0.001$: highly significant probability.

Table 2. Summary of average economic performance indicators (± standard deviation) for all markets surveyed.

Market	Adjamé	Yopougon	Abobo	Anyama	Plateau	Azaguié	Average	Statistics	
								F	P
ASQ (kg/week)	210 ± 8.2	95 ± 4.6	145 ± 8.5	141 ± 6.4	177.5 ± 2.5	125 ± 10.2	148.83 ± 6.73	-	-
AP (Fcfa/kg)	445 ±75 [a]	480 ± 95 [a]	430 ± 75 [a]	435 ± 55 [a]	552 ± 45 [b]	410 ± 15 [a]	458,66 ± 60	1.64	0.45ns
ASP (Fcfa/kg)	880 ± 105 [a]	945 ± 110 [a]	815 ± 95 [a]	780 ± 60 [a]	1 150 ± 125 [b]	805 ± 125 [a]	895,83 ± 103,33	18.3	≤ 0.05.
GM (Fcfa/Month)	262,100 ± 5,200 [ab]	125,750 ± 3 250[a]	116,250 ± 2,150[a]	99,920 ± 1,580[a]	285,290 ± 2,580[b]	100,450 ± 2,725[a]	164,960 ± 2 915	21.7	≤0.05
NP (Fcfa/Month)	141,500 ± 1,425 [b]	71,150 ± 2,105[a]	90,850 ± 3,105[a]	90,220 ± 3,175[a]	180,290 ± 4,280[b]	88,250 ± 2,315[a]	110,376.66 ±2,734.16	21.7	≤0.05
FP (%)	78.12	79.90	74.94	74.77	92.60	86.68	81.16		

ASQ: Average Supply Quantity, AP: Average Purchase Price, ASP: Average Selling Price per kilogram were determined, GM: Gross Margin, NP: Net Profit, FP: Financial Profitability
The values assigned to the different letters are statistically different at the 5% threshold (tukey test); p ≤ 0.05: significant probability.

3.4. Difficulties Encountered in Carrying out the Activity

The survey conducted identified the problems faced by mangosteen traders. The analysis of the data revealed that conservation (CSV) and lack of knowledge of the fruit (LK) are the most important problems. Fruit preservation remains the most important with 48.04% of the problems encountered. Unfamiliarity with the fruit represents 22.11% of the problems encountered by traders. These problems were encountered most in the Abobo and Anyama markets, unlike the Plateau market. The Chi 2 test revealed that unfamiliarity with the fruit is linked to the commune. Other difficulties were also noted, namely the cost of supply (CS: 13.1%), availability of the fruit (AF: 6.62%) and storage infrastructure (SI: 10.1%) (Figure 4). A virtual absence of storage or processing infrastructure for surpluses was strongly felt in the various markets.
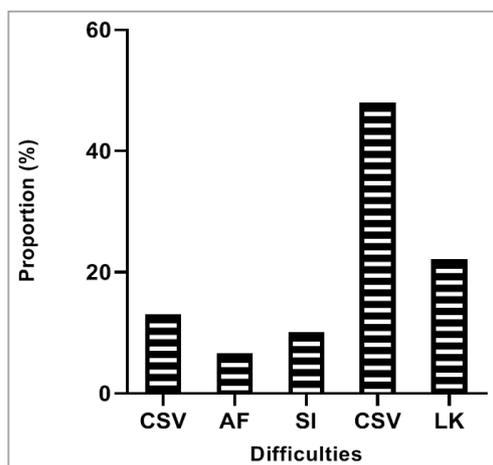

Figure 4. Histogram of difficulties encountered in the mangosteen trade.

CSV: Conservation, LK: Knowledge of the fruit, CS: Cost of supply, AF: Availability of the fruit, SI: Storage infrastructure.

4. Discussion

The survey provided several pieces of information on the mangosteen trade. The socio-demographic characterisation of the traders revealed that this activity is carried out exclusively by women, mainly from the north of Côte d'Ivoire, whose average age is between 25 and 30 years. The strong presence of women in this area of activity could be explained by the very important role they play in the trade of food products in Côte d'Ivoire, particularly fruit [2]. Also, the very low schooling rates of women in Côte d'Ivoire in the past would have led them to turn to income-generating activities such as the fruit and vegetable trade in order to improve their income and financial means. This fact could also justify the very low school enrolment rate observed in the various markets surveyed [12, 13].

The moderately short sales channel favoured by traders could be explained by the fact that most producers develop a marketing network that allows them to have a higher profit margin on the sale of their products without having to go through wholesalers or semi-wholesalers.

The assessment of the financial profitability of the mangosteen trade revealed that apart from the Plateau fruit market, gross and net profit margins were homogeneous in the other markets surveyed. This difference was reflected in the composition of two homogeneous groups in the Tukey HSD test. The difference in margins and net profits between the different markets could be justified by the purchase and sale price of a kilogram of mangosteen on the different markets and by the level of income of the inhabitants frequenting these markets. Indeed, the selling prices charged at the Plateau fruit market (the business district of the city of Abidjan, where most of the administrative and commercial activities take place) are much higher than those charged in the other markets of the district. Similar results were obtained by Kouassi et al [14], whose studies showed that the buying and selling prices of snails (Achatina achatina) in Côte d'Ivoire varied according to the social class of potential customers.

The mangosteen trade proved to be a very profitable activity with economic returns well above the 10% threshold value. The average financial profitability obtained across all markets was 81.16%. This shows the important role that this activity could play in improving people's standard of living. The very high economic profitability observed on each of the markets could be justified on the one hand by the very large gap observed between the average purchase and sale prices of mangosteen and on the other hand by the relatively low operating cost of the activity. Indeed, the average selling price

per kilogram of mangosteen (895.83 ± 103.33 CFA francs) is almost double the average purchase price (458.66 ± 60 CFA francs), which tends to increase the net profit and therefore the financial profitability. It is therefore right that 97.8% of the traders interviewed affirmed that the marketing of this fruit is profitable. Also, the very long production cycle of the mangosteen tree (more than 10 years) has been a brake on the spread of its cultivation. As a result, the mangosteen has become very rare and sells at higher prices than most fruits (between 200 and 325 Fcfa/kg for mango, between 172 and 258 Fcfa/kg for sweet banana and between 178 and 320 Fcfa/kg for pineapple) [15, 16]. Similar results were obtained by Demont [17] who, after an analysis of the food marketing system in Côte d'Ivoire, revealed that the food trade was profitable and allowed actors to take charge of themselves.

Although the mangosteen trade is lucrative, it faces several difficulties, the most important of which are conservation and lack of knowledge of the fruit by the general public. The problem of preservation alone accounts for more than 48% of the problems encountered by traders. Indeed, like most climatic fruits, the mangosteen is highly perishable. This constraint is not specific to the mangosteen trade, but characterises the problems encountered in the fruit trade in general. However, it could be explained by the lack of knowledge of appropriate preservation techniques and by the lack of preservation infrastructure. Indeed, very few studies have focused on the preservation of the mangosteen, although this fruit can be kept for only a few days at room temperature (3 to 7 days) [3]. The problem of lack of knowledge about the fruit, which accounts for 35.21% of the problems encountered, is due to the fact that this fruit is reserved for a certain class of the population. Considered too expensive, the mangosteen is therefore the preserve of the wealthy and more affluent. Added to this is the fact that the mangosteen is a fruit mainly intended for export.

5. Conclusion

At the end of this study, it emerged that the mangosteen trade is carried out exclusively by women, most of whom are from the north of Côte d'Ivoire. This trade is a very lucrative activity that allows the women involved to support themselves by meeting several expenses, as the profitability obtained on all the markets surveyed was over 10%. The marketing of this fruit could therefore constitute a real opportunity for economic and social development for the population, as the profits generated by this activity could contribute to improving the living conditions of the population.

6. Recommendation

As this study is not exhaustive, it opens up new avenues of research. It would be wise to extend this research by analyzing the competitiveness and economic impact of the mangosteen sector in Côte d'Ivoire, to study the viability of the activity and its real contribution to the agricultural economy.

Acknowledgements

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