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ABSTRACT

The aim of this study was to characterize the local market part of the value chain of *Carapa procera* oil in Mali. The data were collected in four local markets using semi-structured individual interviews, focus groups and participant observations. Three sources of oil supply were identified, one national and two from neighbouring countries. Semi-wholesalers obtained the highest profit margins per litre. Four marketing channels were identified, and the profit margins of traders varied depending on the channel. The market concentration ratio showed an oligopoly market structure, indicating that the market was not competitive. The average annual income of traders was US\$ 221.53, which represented 63.3% of the poverty threshold estimated at US\$ 350 in 2016 in Mali. However, there is a potential for much higher gains and a more efficient marketing system. Knowledge about the structure and distribution of profits and margins along the market part of the value chain provides information to policy makers about the potential for improving the income of traders and other actors and also highlights the opportunities that the marketing of oil could contribute to local and national economies.

Introduction

Marketing of non-timber forest products (NTFP) is an increasingly important source of cash income in household economies in the third world (Timko et al. 2010). Therefore, development of NTFP markets creates opportunities for increased income and food security for people in Africa. Several authors have shown the importance of NTFP and their potential contribution to poverty reduction through sustainable trade and income generation. In Mali, Gakou et al. (1994) identified 55 NTFP produced by 108 plant species, of which 99% were used for consumption and 68% to generate income. Gustad et al. (2004) showed that NTFP had both economic and cultural value in Mali, and many local plant species had multiple uses. NTFP contributed with an average of 46% of the total household income, with a range from 26 to 73% and an income up to

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US$ 650 per year for households whose primary source of income was agroforestry in the Ségou region of Mali (Faye et al. 2010). NTFP accounted for 39% of the total household income in Benin and had a strong equalizing effect on income groups (Heubach et al. 2011). NTFP provided a yearly average of US$ 145 per household in southern Burkina Faso, and the households' economic dependence on NTFP was 12% (Ouédraogo et al. 2013). In Benin, one single species, tamarind, contributed from 9 to 56% of income in rural households (Fandohan et al. 2010). There are many examples of the importance of NTFP both in terms of income and food security, but the importance varies greatly among communities.

Use, processing and marketing of NTFP constitute employment opportunities and income generating activities for people in rural areas and in urban centres. NTFP collection – either for subsistence or as an income generating activity – is an important means for reducing poverty (Timko et al. 2010). One example is shea nut collection and processing in two regions of Burkina Faso that provided a valuable source of cash income to female household members with very few alternative income possibilities (Pouliot 2012). Production and commercialization created several jobs, including pickers, traders, rural and urban processors, small-scale entrepreneurs and exporters (Bup et al. 2014).

Conservation efforts have, in some cases, been promoted by the economic value of NTFP, e.g. for shea (Pouliot 2012; Bup et al. 2014), *Parkia biglobosa* (Kronborg et al. 2013), *Prosopis africana* (Laouali et al. 2014) and *Borassus akeassii* (Yaméogo et al. 2008). In Mali, *Carapa procera* has been identified and ranked as a species that deserves sustained attention from the national authorities in charge of forest policy (Maiga 2001). It has also been identified as one of twelve utilitarian native oil tree species in the Sikasso region of Mali (Kouyaté et al. 2015). The genus *Carapa* belongs to the Meliaceae family, and is represented by two species (*C. procera* and *C. velutina*) in Mali and its neighbouring countries. The two species have only subtle differences and are not distinguished by collectors when collecting the seeds. *Carapa procera* and *C. velutina* (hereafter simply named "Carapa") occur in a range of habitats from gallery forest in savanna areas to humid forest. In Mali their flowering occurs from January to March, and fruiting from May to July. A typical Carapa fruit consists of a capsule with 4–5 valves, each enclosing 2–5 seeds (Weber et al. 2010). Various parts of the tree (bark, leaves, gum, nuts, roots and wood) are used by local communities in southern Mali. These parts are used in traditional human medicine, cosmetics, veterinary medicine, as an insecticide treatment, as well as for magico-spiritual purposes and energy. Nuts are the most exploited plant part. Women extract the seeds to produce an oil which has a range of applications in human and veterinary medicine, cosmetics, pharmaceuticals and biotechnology although its main local uses are medicinal (treat various skin and gastro-intestinal diseases), as a cosmetic and for local soap production (Dembélé et al. 2015). Carapa oil is also used in the phytosanitary treatment of cotton as part of the organic cotton production programme in Mali (Sanogo and Favreau 2007). Despite of the local importance and of Carapa oil and its large range of uses, there was no information on its marketing in Mali, the quantities traded on the markets, their sources, prices, margins and market agents. This study aims to contribute to filling this gap by analysing the market part of the Carapa oil value chain, identifying the main actors and characterizing the market structure and performance, as a basis for improving the market value of Carapa oil and the income it could generate for all involved actors.

Material and methods

Study area

The study was conducted in four markets where Carapa oil is sold. These markets were identified following an exploratory study. This exploratory study was conducted from January to February 2013 to identify and characterize the actors involved in the Carapa oil value chain. It was carried out in the localities of Kountjila (Commune of Niéna), Mogoyéboubou (Commune of Kaboila), Mourasso (Commune of Kofan), N'torla (Commune of Pimperna), Sénani (Commune of Lobougoula), Ziékorodougou (Commune of Finkolo) and Yanfolila (Commune of Wassoulé-Balé) in the Sikasso region, Koumabougou (Commune of Massigui in the Dioila Circle) in the Koulikoro region, Faraba 2 (Commune of Sirakoro in the Kita Circle) and Sandama (Commune of Sobra in the Kati Circle) in the Kayes region. It included the markets of Sikasso, Bougouni, Yanfolila, Kadiolo, Koutiala and Bamako.

The choice of markets was based on criteria consistent with Wiersum et al. (2014): local market, close to the production areas (main township of the circle, Bougouni and Yanfolila), regional market (regional capital, Sikasso) and national market, large urban market (capital of the country, Bamako) (Figure 1). These markets are described as follows:

Type I: Bougouni and Yanfolila (markets at local level). Bougouni is located on the Bamako-Sikasso road, 170 km southeast of Bamako and 210 km at west of Sikasso. Yanfolila is located 100 km south-west of Bougouni. These markets are considered local markets proximate to supply zones with high level of self-sufficiency, high levels of local
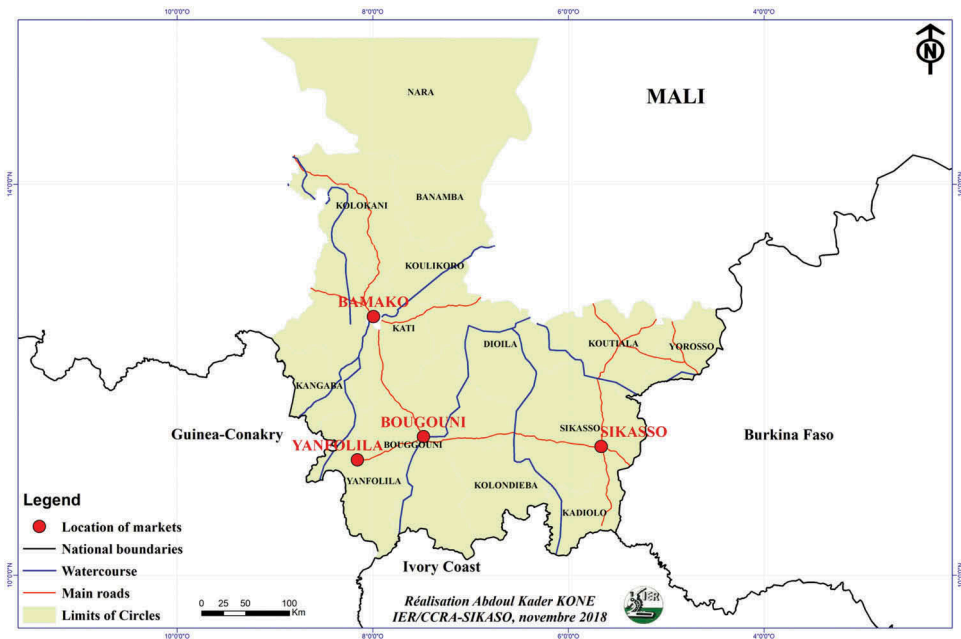

Figure 1. Location of study sites in southern Mali.

supply and exchange, often direct transaction between producer and consumer, suppliers for regional and national markets.

Type II: Sikasso (market at regional level). Sikasso is the capital of the Kénédougou region (3rd administrative region of Mali) located 380 km at southeast of Bamako, 100 km from the border of Côte d'Ivoire and 45 km from that of Burkina Faso. Sikasso is by geographical and economic position, a crossroads city. The market surveys concentrated on the central market, a medium-sized market of regional importance with medium level of self-sufficiency, intermediaries often involved in transactions, secondary nodes for Type I and intermediate markets, bulking points for Type III markets.

Type III: Bamako (market at national level). Large urban markets located in the capital with national range of products and weak self-sufficiency, reliance on close and far supply areas, chain of intermediaries involved in transactions, hubs for Type I and II markets. In Bamako, the surveys were carried out in the main points of sale of NTFPs (Artisanat, Medine, Djicoroni-Para and Sebenicoro).

Interviews

Data collection was carried out through formal qualitative and quantitative surveys. These surveys were conducted from March to November 2014 using individual semi-structured interviews with 45 traders (Table 1). Traders were identified using the snowball method, and in each market all the listed Carapa oil traders were surveyed. The categorization of traders was then made in accordance with the nature of their trade in general. Each respondent was informed in advance of the purpose of the study, and their consent was obtained.

Socio-economic characteristics of traders (sex, age, marital status, level of education, economic activities) were registered. Traders were asked about the source and method of supply, quantities marketed, quality of the oil, purchasing and selling prices, factors of price variation, measuring instruments used, marketing costs, marketing constraints and opportunities, funding sources, and existence of a professional organization related to Carapa oil. Information on the quantities and purchasing price of oil according to supply sources for the two previous years was also collected.

During market surveys, direct and participatory observations were made on marketing of the product as suggested by Ingram and Bongers (2009). Formal data were enhanced by informal discussions with resource persons for triangulation and validation. This technique allowed identification of alternative routes of product flow. Oil samples were purchased to

Table 1. Number of traders investigated by category and type of market.

| Trader category | Markets | | | | | | | | | |
| | National (Bamako) | | Regional (Sikasso) | | Local (Bougouni) | | Local (Yanfolila) | | Total | |
	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)
Wholesalers	5	26.3	3	30.0	1	12.5	1	12.5	10	22.2
Semi-wholesalers	3	15.8	3	30.0	3	37.5	2	25.0	11	24.4
Retailers	11	57.9	4	40.0	4	50.0	5	62.5	24	53.3
Total	**19**	**100.0**	**10**	**100.0**	**8**	**100.0**	**8**	**100.0**	**45**	**100.0**
Quantity of oil marketed (litre)	2 828	54.5	464	8.9	498	9.6	1 398	26.9	5 188	100.0
CR4	2 000	71	340	73	448	90	1 358	97	2 615	50

verify selling units, prices and quality of the oil marketed. The price values were collected in the local currency (XOF) and converted to US dollars (500 XOF equal to 1 US $, exchange rate based on the conventional rate applied locally at time of study).

Data analysis

Value chain was mapped by identifying the stakeholders and their connections according to te Velde et al. (2006). Analysis of market performance was conducted to assess the economic efficiency of the structure and behaviour of the market. This was done by calculating value added, marketing costs and profit margin for traders. Value added and profit margin per litre of Carapa oil were calculated using KIT and IIRR (2008).

$$VA_{tr} = SP - PP \tag{a}$$

$$PM = VA - MC \tag{b}$$

where VA_{tr}: value added for traders; SP: selling price; PP: purchase price; PM: profit margin; MC: marketing costs. The calculation of MC was based on transaction or transfer costs (transportation, labour) and other fees (taxes) incurred by each actor. Degree of market concentration was calculated based on concentration ratio of the first four traders (CR4) with the largest volume of product traded compared to all market traders according to Kohl and Uhl (1985). A ratio of 50% or more indicates a narrow oligopoly market structure, between 33 to 50% a weak oligopoly and less than 33% a competitive sector.

Marketing channels were used in the analysis of supply chain performance. Market performance was evaluated in the different channels according to Mendoza (1995):

$$TGMM = \frac{End\ buyer\ price\ -\ Purchase\ price}{End\ buyer\ price}\ x\ 100 \tag{c}$$

where TGMM = Total gross marketing margin.

To find the profit share of each actor (e.g. retailer, semi-wholesaler, wholesaler), the same concept was applied with some adjustments. Gross marketing margin at a given stage 'i' (GMMi) was computed as:

$$GMMi = \frac{SPi - PPi}{End\ buyer\ price}\ x\ 100 \tag{d}$$

where SPi = selling price at ith link; PPi = Purchase price at ith link.

$$NMM = \frac{Gross\ marketing\ margin\ -\ Marketing\ costs}{End\ buyer\ price}\ x\ 100 \tag{e}$$

where NMM is the net marketing margin (the percentage over the final price earned by the intermediary as his net income, once his marketing costs are deducted).

Results

Socio-economic characteristics of traders

Three categories of traders were identified according to the nature of their activities in Carapa oil marketing: wholesalers, semi-wholesalers and retailers (Table 2). Men were predominant (71%) in marketing. Women were fairly represented in semi-wholesale and retail, but weakly represented in wholesale. The majority of traders were married. More than half of semi-wholesalers and retailers were illiterate. However, 33% of retailers and 30% of wholesalers had attended formal school.

The traders were between 26 and 67 years old with an average age of 45 years. Wholesale traders were the oldest with an average age of 47, while retailers and semi-wholesalers had an average age of 44 years. The experience in marketing of Carapa oil was 12 years on average. Wholesalers had more experience (17 years) than the other categories of traders (10 years for semi-wholesalers and retailers, respectively), as they progressed from the lower-stage retail and semi-wholesaler categories. Compared to their trading experience, marketing of Carapa oil was more recent. The experience in trade was 30, 21 and 24 years for wholesalers, semi-wholesalers and retailers, respectively, with an average experience of 24 years. The majority of stakeholders (80%) adopted commercialization of Carapa oil to diversify their traded products and income, 18% responded to customer and buyer demands and 2% had an offer from a supplier.

Quantities, prices, sources and quality-related standards of Carapa oil

Three sources of Carapa oil were identified: national, from the Republic of Côte d'Ivoire (hereafter named Côte d'Ivoire), and from the Republic of Guinea (hereafter named Guinea). Bamako market is supplied mainly by Guinea and national production. Markets of Sikasso, Bougouni and Yanfolila are supplied by national production and Guinea- and Côte d'Ivoire. From 2011 to 2013, there was a 4% decrease in the supply of Carapa oil. This decrease is mainly due to the decrease in supply from Côte d'Ivoire, which has not been offset by the increase in the share of national production as well as that of Guinea. Guinea oil accounted

Table 2. Socio-demographic characteristics of investigated traders.

Characteristics of traders	Wholesalers (n)	(%)	Semi-wholesalers (n)	(%)	Retailers (n)	(%)	Total (n)	(%)
Sex								
Male	9	90.0	7	63.6	16	66.7	32	71.1
Female	1	10.0	4	36.4	8	33.3	13	28.9
Marital status								
Single	0	0.0	0	0.0	2	8.3	2	4.4
Married	10	100.0	11	100.0	20	83.3	41	91.1
Window	0	0.0	0	0.0	2	8.3	2	4.4
Level of education								
Illiterate	3	30.0	6	54.5	13	54.2	22	48.9
Koranic studies	1	10.0	1	9.1	1	4.2	3	6.7
Alphabetized/literate in local languages	3	30.0	2	18.2	2	8.3	7	15.6
Formal school	3	30.0	2	18.2	8	33.3	13	28.9
Resident status								
Autochthone	3	30.0	3	27.3	11	45.8	17	37.8
Allochthone	7	70.0	8	72.7	13	54.2	28	62.2

for 51% of market supply in 2013. However, the supply of nationally produced oil increased from 22% in 2011 to 25% in 2013. During this same period, the market share from Côte d'Ivoire went down from 30 to 24% (Table 3).

Nationally produced oil was more expensive than oil from the two neighbouring countries. From 2011 to 2013, purchase prices per litre increased by 3.5% for Guinea-Conakry oil (US $ 3.96 in 2011 to US $ 4.10 in 2013) and 11.3% for Ivory Coast oil (US $ 3.00 in 2011 to US $ 3.34 in 2013). Prices fell by 2.4% for nationally produced oil (US $ 5.05 in 2011 to US $ 4.93 in 2013). This decrease in national prices favoured an increase in the market share of nationally produced oil. Prices of Carapa oil were generally low during the oil production period from November to February (the cold period).

Related to price determination, 78% of traders negotiated the purchase prices at the sources of supply. A few (4%) traders bought the oil directly at the price set by the suppliers. In total, 18% of traders set their prices to suppliers. The source of supply (39%) and the selling period (33%) were the main determinant factors in sales price of oil by traders (Figure 2).

Norms and standards of oil quality were evaluated through the responses given by the traders. In total, 36% only checked for the absence of solid substances in the oil, 31% considered colour and purity (clarity) of oil, 9% considered the taste and colour of the oil, as the bitter taste is a specific attribute to Carapa oil, and 24% did not consider norms and standards in oil quality at purchase.

Table 3. Quantities and share of Carapa oil in the four studied markets, by supply source.

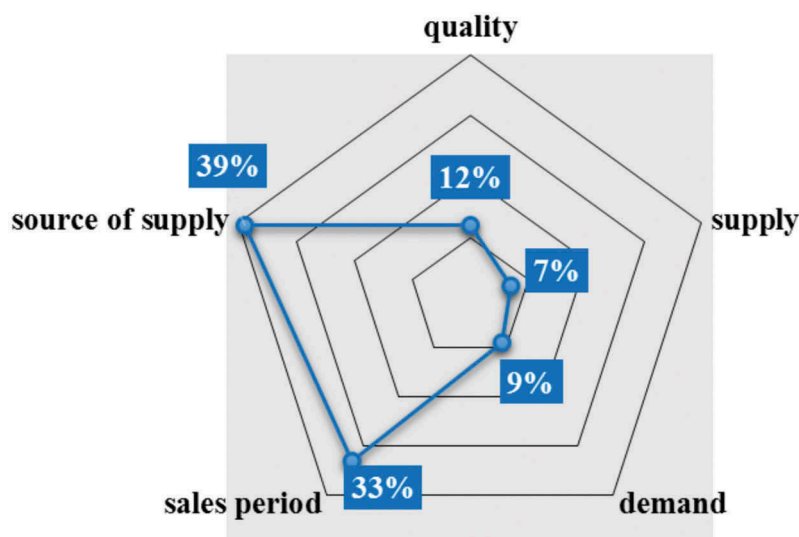|	2011		2012		2013	
Supply sources	Quantity (litre)	(%)	Quantity (litre)	(%)	Quantity (litre)	(%)
National (Mali)	1185	21.9	1261	23.6	1290	24.9
Côte d'Ivoire	1607	29.7	1688	31.6	1255	24.2
Guinea	2610	48.3	2385	44.7	2643	50.9
Total	**5402**	**100.0**	**5334**	**100.0**	**5188**	**100.0**

Figure 2. Factors influencing sales prices.

Market performance of carapa oil

Traders in the national market of Bamako obtained the highest value added (US $ 2.79 per litre) and those in the local market of Yanfolila the lowest (US $ 2.25 per litre) (Table 4). Traders in the Bougouni local market obtained the highest average marketing costs (US $ 0.53 per litre) and those in the regional market of Sikasso the lowest (US $ 0.17 per litre). The profit margin was highest in the Bamako market (US $ 2.44 per litre), followed by the Sikasso market (US $ 2.13 per litre), and the Yanfolila local market had the lowest profit margins (US $ 1.92 per litre). There is no significant difference at the 5% threshold in value added and profit margins among traders according to market.

Value added, marketing costs and profit margins by type of traders

Semi-wholesalers obtained the highest value added (US $ 2.68 per litre) and retailers the lowest value added (US $ 2.46 per litre) (Table 5). Wholesalers had the highest marketing costs (US $ 0.48 per litre) and retailers the lowest (US $ 0.28 per litre). Semi-wholesalers had the largest profit margins (US $ 2.34 per litre) followed by retailers (US $ 2.18 per litre). Wholesalers obtained the lowest profit margins (US $ 2.07 per litre), but they sold the largest quantities. There is no significant difference at the 5% threshold in value added and profit margins among categories of traders.

Average annual income of traders and degree of market concentration

The annual income from the marketing of Carapa oil was generally below US $ 200 - per year. The average annual income of the investigated traders was US $ 221.53, as 16% of the traders generated more than US $ 350 and 11% between US $ 200 and 350.

The market concentration ratio for the first big traders (CR4) of each individual investigated market was higher than 50% of market share and showed a narrow

Table 4. Analysis of market performance according to market.

Variables (in US $/litre)	Bamako (n = 19)		Sikasso (n = 10)		Bougouni (n = 8)		Yanfolila (n = 8)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Purchase price (PP)	4.76	1.24	4.20	0.59	4.00	0.76	4.88	1.13
Selling price (SP)	7.55	2.37	6.50	0.97	6.50	0.89	7.13	1.13
Value added (VA)	2.79	1.57	2.30	0.71	2.50	0.60	2.25	0.71
Marketing costs (MC)	0.35	0.37	0.17	0.24	0.53	0.40	0.33	0.31
Profit margin (PM)	2.44	1.51	2.13	0.77	1.97	0.90	1.92	0.69

Table 5. Analysis of market performance by category of traders.

Variables (in US $/litre)	Wholesalers (n = 10)		Semi-wholesalers (n = 11)		Retailers (n = 24)		Total (n = 45)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Volume of Carapa oil marketed (litre)	356	311	80.5	53.5	30	35	115	196
Purchase price (PP)	3.55	0.69	4.18	0.84	5.08	0.92	4.52	1.06
Selling price (SP)	6.10	1.45	6.86	1.70	7.54	1.76	7.06	1.75
Value added (VA)	2.55	0.96	2.68	1.21	2.46	1.22	2.53	1.14
Marketing costs (MC)	0.48	0.37	0.34	0.35	0.28	0.34	0.34	0.35
Profit margin (PM)	2.07	1.07	2.34	1.21	2.18	1.19	2.19	1.15

oligopoly market structure. The CR4 was 97%, 90%, 73% and 71% for the Yanfolila, Bougouni, Sikasso and Bamako markets, respectively. These ratios indicate that the Carapa oil market is dominated by a few large traders in these individual markets. The global concentration ratio for the first 4 major operators of all traders in the investigated markets was 50%, which indicates a bordering weak oligopoly market structure at national level.

Marketing channels, marketing margins and profit share of traders

Four alternative channels were identified for Carapa oil marketing during investigations (Figure 3).

Market performance along the market chain indicated that traders shared 31.41%, 35.51% and 33.08% of the profit margin for wholesalers, semi-wholesalers and retailers, respectively (Table 6).

Marketing margin analysis for the market channels showed that the total gross marketing margin was highest (52.92%) in channel III and IV due to the high selling price earned by retailers in these channels (Table 7). The lowest total gross marketing margin (41.80%) was in channel I, when consumers payed wholesalers directly. The semi-wholesalers account for a gross margin 39.07% in channel II and 11.94% in channel
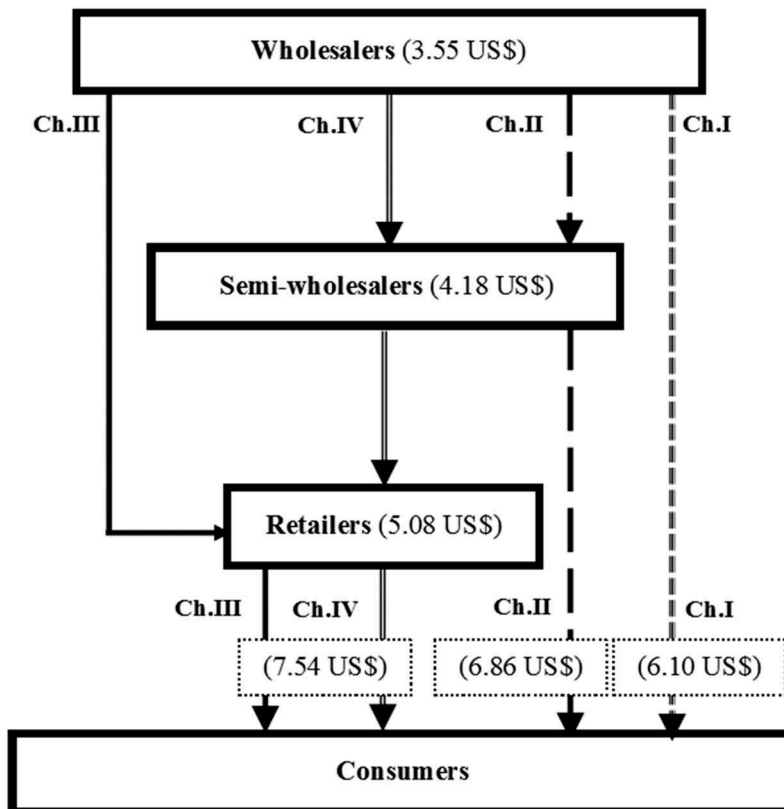

Figure 3. Marketing channels of Carapa oil in three types of markets (national, regional and local).

Table 6. Analysis of market performance of traders along the market chain.

Items (in US $/litre)	Traders			Total
	Wholesalers	Semi-wholesalers	Retailers	
Purchase price (PP)	3.55	4.18	5.08	12.81
Marketing costs (MC)	0.48	0.34	0.28	1.10
Selling price (SP)	6.10	6.86	7.54	20.50
Value added (VA)	2.55	2.68	2.46	7.69
% share of Value added	33.16	34.85	31.99	100
Profit margin (PM)	2.07	2.34	2.18	6.59
% share of profit	31.41	35.51	33.08	100

Table 7. Traders' marketing margins per marketing channel.

Marketing Margins (%)	Channels			
	I	II	III	IV
TGMM	41.80	48.25	52.92	52.92
GMMw	41.80	9.18	20.29	8.36
GMMsw		39.07		11.94
GMMr			32.63	32.63
NMMw	33.93	30.17	27.45	27.45
NMMsw		34.11		31.03
NMMr			28.91	28.91

TGMM: Total gross marketing margin; GMMw: Wholesaler's share in consumer price; GMMsw: Semi-wholesaler's share in consumer price; GMMr: Retailer's share in consumer price.
NMMw: Wholesaler's share in net marketing margin; NMMsw: Semi-wholesaler's share in net marketing margin; NMMr: Retailer's share in net marketing margin.
Channel I: Wholesaler to Consumer
Channel II: Wholesaler to Semi-wholesaler to Consumer
Channel III: Wholesaler to Retailer to Consumer
Channel IV: Wholesaler to Semi-wholesaler to Retailer to Consumer

IV, whereas the wholesalers get the highest gross margin (41.80%) in channel I and the lowest (8.36%) in channel IV. Retailers obtained the same gross margin (32.63%) in channels III and IV. Concerning net marketing margin, the highest profit share of consumer price (34.11%) was captured by semi-wholesalers in channel II, whereas wholesalers obtained the lowest share of profit margin from the consumer price (27.45%) in channel III and IV.

Constraints and challenges of traders and consumers in marketing of carapa oil

Major constraints in marketing of Carapa oil included slow transaction flow (50%), lack of product promotion (29%), supply difficulties (17%), road fees and insufficient financial resource (2%).

Consumers were mainly composed of 34.5% traditional therapists (for magico-spiritual values), 24.5% farmers (for organic production), 24.5% breeders (for animal treatment and veterinary care), 12.7% individuals and 3.6% projects.

The conventional sales unit is the litre. However, the price per litre of oil differs according to the categories of traders. On average, the litre is sold to consumers at US$ 6.10 by wholesalers, US$ 6.86 by semi-wholesalers and US$ 7.54 by retailers. At the retail level, semi-wholesalers and retailers use other units of measurement including the 350 ml bottle at an average price of US$3.54, and the 80 ml glass at a price of US$1.08.

Discussion

Men predominate in marketing of Carapa oil; however, women also participate in the market chain, but mainly at the retail levels. The frequent number of trips in the wholesale trade is a factor that very often handicaps women as they are faced with household obligations and the lack of support from their husbands.

Wholesalers have the highest education because it is an asset for good conduct of activities at this level of trade. A good level of education promotes efficient flow of market information, which ensures better functionality of the value chain. In contrast, more than 50% of semi-wholesalers and retailers are illiterate. According to Shively et al. (2010), the low level of education of retailers may be a disadvantage in the bargaining processes due their limited access and ability to process market information. The marketing of Carapa oil is a relatively recent activity for traders. This suggests that marketing of Carapa oil is a young value chain with high prospective potential. Barirega (2014) pointed out the same finding in the marketing of *Physalis peruviana* and deduced that this might indicate prospects for future growth in the activity.

The slight increase in market supply of national production of Carapa oil is due to the growing interest in organic farming in Mali through the use of Carapa oil as a natural repellent in the cultivation of organic cotton (Sanogo and Favreau 2007; Weber et al. 2010). A seasonal variation in prices was found, which is common in the sub-Saharan African countries and described for other products as well, e.g. shea (Dandjouma et al. 2009), gum and resin (Mekonnen et al. 2013).

Market structure showed that retailers were the more numerous, however, the market concentration ratio for the first four big traders of Carapa oil showed a narrow oligopoly market structure in each market and a bordering weak oligopoly market structure at national scale.

Market performance according to type of market showed that traders in the national market of Bamako recorded the highest value added compared to both the regional market of Sikasso and the local markets in Bougouni and Yanfolila. Traders in the local market of Yanfolila scored the lowest value added. This price level is related to the standard of living, and purchasing power is higher in the urban cities than in the rural areas. Similarly, the profit margins of stakeholders varied according to the type of market. Profit margins were the highest in national and regional markets. These results support the assertion by Ndoye et al. (1998) that profit margins reflect the large average size of businesses in large city markets.

There was no formal system of information on the Carapa oil marketing, resulting in a low flow of market information through the system, that limits the full market integration and efficiency of all participants in the value chain development.

Marketing of Carapa oil generates an average annual income estimated at US$ 221.53, equivalent to 63.3% of the poverty threshold estimated at US$ 350 in 2016 in Mali (INSTAT 2017). Analysis of the average annual income from Carapa oil sales per type of trader showed that 16% generated substantial income above the poverty line. The monetary exchange value per litre of Carapa oil, estimated at an average of US$ 7.54 in the studied markets, is important. This exchange value is higher than that of shea butter (*Vitellaria paradoxa*) estimated at US$ 2 per kilogram on local markets in Burkina Faso (Pouliot 2012). Thus, the sale of a large volume of Carapa oil could contribute significantly, not only to increasing the income of the actors, improving their livelihoods, but also to reducing poverty.

Conclusion

Marketing of Carapa oil generates substantial added value and is therefore a wealth-creating activity with a potential for poverty reduction in rural communities and urban areas. Carapa oil value chain is still young and has not yet reached its full potential of development. The market of Carapa oil is weakly competitive in the studied local markets, which are dominated by a few wholesale traders, and relatively competitive at national scale. Slow product flow, lack of product promotion and supply difficulties were the major constraints for traders. Our results highlight the need for actions to remove these constraints and find solutions to ensure the sustainable use and the conservation of the Carapa tree resource, which could even be promoted through the establishment and management of plantations. Our results also highlight the need to find realistic and sustainable ways to improve the equitability and efficiency of the value chain, so that the livelihoods of all actors along the value chain could be improved.

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