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Management of shells of giant African snails (Achatinidae) from the markets of Abidjan (Côte d'Ivoire).

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ABSTRACT

Objective: this study aimed to estimate the amount of snail's shells produced in the Abidjan City and the mode of management of empty shells for possible reuse.

Methodology and Results: An investigation was carried out by a questionnaire on 120 snail retailers' in the markets of Abidjan. The data was stripped by Sphinx Plus 2 software to study (1) the marketing system of the snail in city of Abidjan, (2) the origin and the mode of collection of animals sold in Abidjan; (3) the quantity of snail per year and (4) the management of shells.

The trading of the snail in Abidjan is exclusively done by women of all ages, educated and noneducated. Retailers provide approximately 1,900 tons per year of empty shells, from wild harvesting of the forests of western and south-western areas of Côte d'Ivoire. A very large part of empty shells is thrown away without sanitation.

Conclusion and application of results: A better understanding of the snail's marketing chain is essential for eventual use of the shell by-product. The markets of Abidjan produced a large amount of empty snail shells, rich in calcium, which are thrown without sanitation, while these shells can be used to correct soil acidity as fertilizer, and for animal feed. Thus, to optimize the use of snail's shells in areas such as agricultural production, livestock feed, medicine, ways for the sustainable management are required.. Finally, the results can help mainly farmers and ranchers to establish their production strategy.

Keywords: Snail, empty shells, environment, Abidjan

INTRODUCTION

Giant African land Snails (Achatinidae) (**Figure 1**) are terrestrial gastropods from East Africa and West Africa (Cowie, 1997; Cobbinah *et al.*, 2008). They live in a natural environment where they spread in different areas of primary forests on anthropized areas (Otchoumou *et al.*, 2004). These gastropods are a source of animal protein in the diet of African people and a significant source of income for some households (Agbelusi and Ejidike 1992; Ekoué and Kuévi - Akue 2002; Sodjinou *et al.*, 2002; Kouassi et *al.*, 2008; Agbogidi and Okonta, 2011). Only the flesh of the animal is so far the important part for the use by the people; other parts are discarded and are a significant source of environmental pollution. However, the shells represented are made up of calcium carbonate ($CaCO_3$) and magnesium (Aboua, 1990). This wealth of mineral elements opens up the prospect of using these shells as fertilizer or soil -calcium magnesium. In addition, to

reach the final consumer, the snail follows a circuit that includes a large number of stakeholders, the collector to the retailer (Mbétid - Bessane, 2006; Kouassi *et al.*, 2008). The present study aims to estimate the amount of shells produced in the municipalities of Abidjan and the mode of management of empty shells for possible recovery.

Figure 1: Specimens of *Achatina achatine* (Scale 1/2)

MATERIALS AND METHODS

Study sites: This study investigation was conducted to the food markets of the cities of Abidjan (**Figure 2**). Abidjan is located in south -east of Côte d'Ivoire with an estimated 5.5 million inhabitants. This study lasted twelve months, from December 2011 to November 2012.

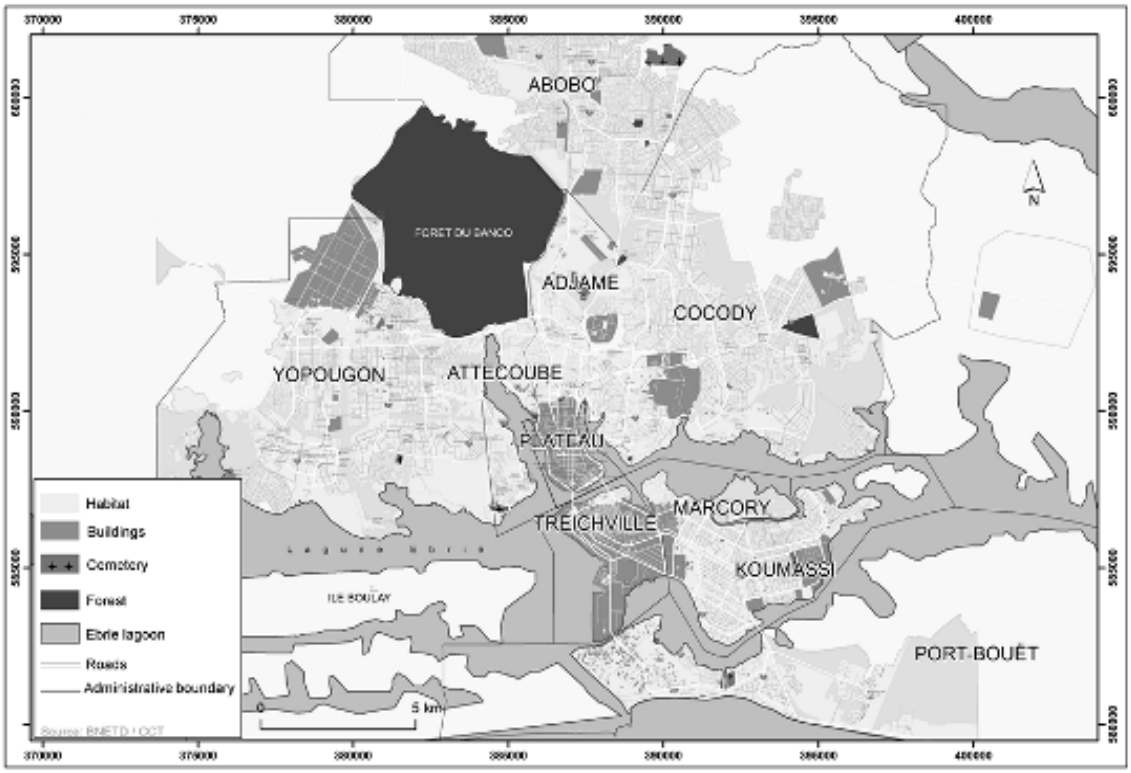


Figure 2: Study site: cities of Abidjan. (bnetd / CCT , 2012)

Methods: The sample consisted of different actors only about the perimeter of the city of Abidjan. The study included 120 detailed sellers randomly selected in different markets of different cities. Data were collected each month from survey forms specifically tailored to the snail seller and designed using the Sphinx Plus2 Application Software. This data collection was performed by holding free interviews in which the forms were completed by the investigator. The data collected focused on (1) stakeholders marketing system of the

snail in Abidjan, (2) the origin and mode of collection of animals sold in Abidjan, (3) the amount of snails sold per year and (4) the administration of shells. The information gathered was stripped by Sphinx Plus2 software.

RESULTS

Origin and mode of collection of snails: The snail species most encountered in Abidjan markets were *Achatina achatina* (Linné, 1758) and *Archachatina ventricosa* (Gould, 1850). These snails were from the forest zone of Côte d'Ivoire though 16 % of retailers did not know the origin of the animals they sold. The department of San Pedro was the first supplier of snails with more than 50 % of the stock sold in Abidjan (**Figure 3**). These snails were available in large quantities during the rainy seasons from different collection areas. *A. achatina* dominates the market during the rainy season in areas of collection (March to July and September to November), whereas *A. ventricosa* dominates the market during the dry season. Almost all (90.83 %) of snails sold in markets of Abidjan were from the traditional collection (court) against 2.5% from the farms of the Adzopé region (**Figure 3**).

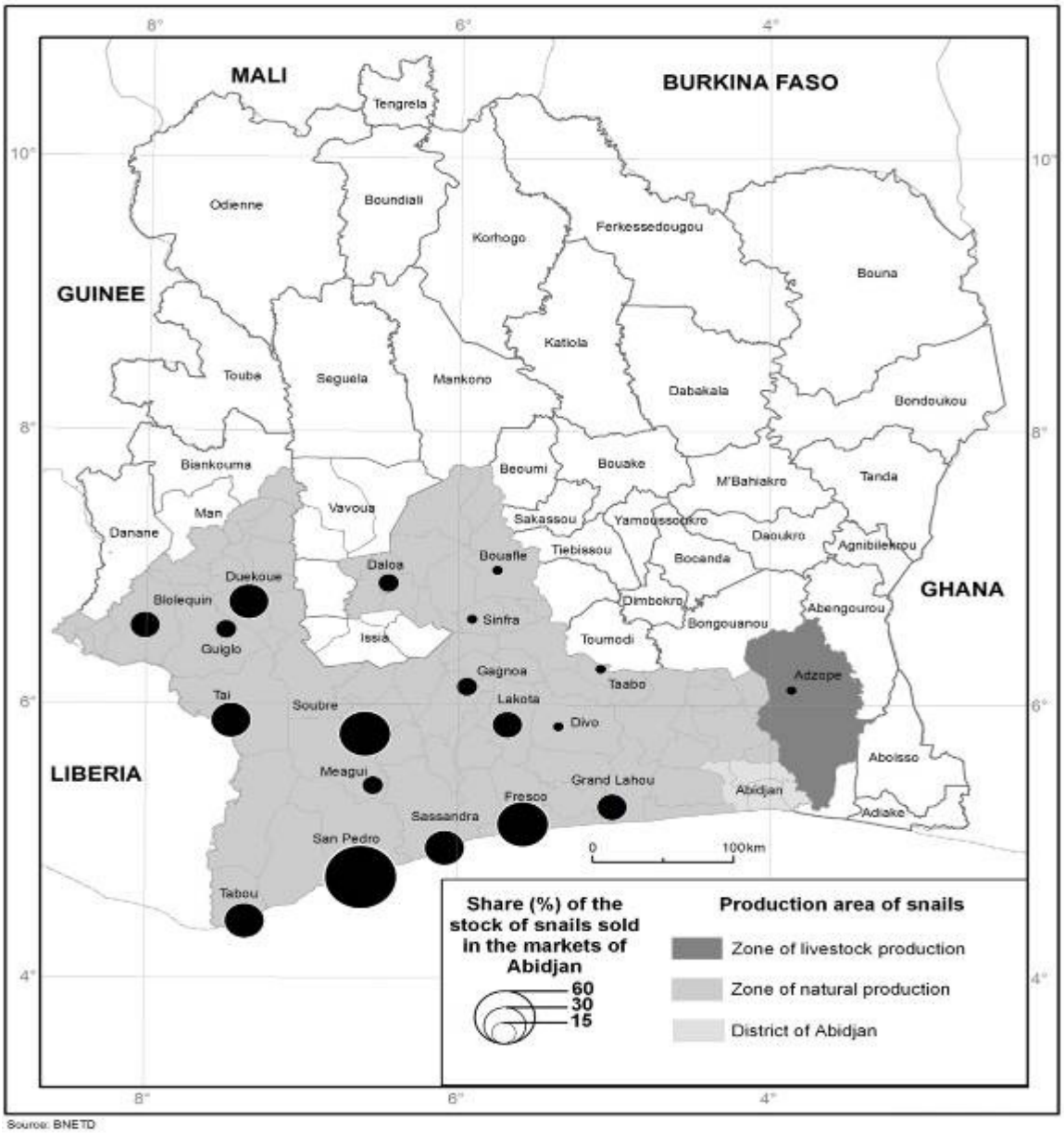


Figure 3: Sources of snails sold in the markets of the city of Abidjan.

Marketing channel of snails in Abidjan: The data gathered was used to establish the general sales channel from the collection areas to the households **(Figure 4**).

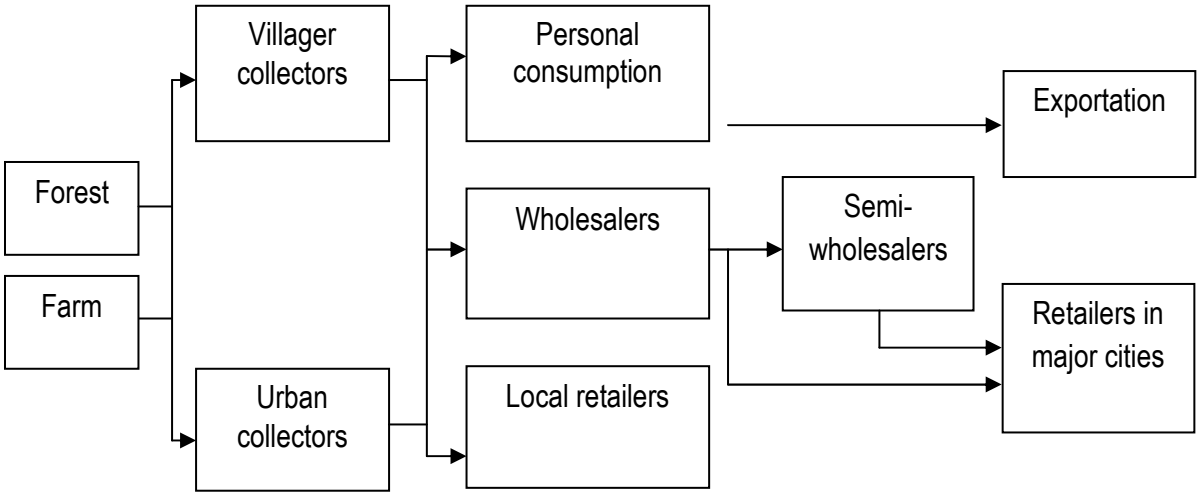


Figure 4: General scheme of marketing channel snails in Côte d'Ivoire

Snails are destined to the place of local market gathering or markets of major cities and recently the export market (especially the Ghanaian market). Snails are transported in nylon bags of 40 kg and sold to retailers in this form. The detailed selling in the cities of Abidjan is mainly done by women. They are of all ages with a very large proportion of women over 18 years (97.5%) as well as children under 18 years (2.5%) in the cities of Adjamé and Yopougon **(Figure 5**). More than half of retailers in Abidjan Detailing (55 %) did not receive any formal education against 45% of educated women. Among the educated retailers, we find women of all grades, primary school (55%), college (28%), secondary (15%) to university (2%) (**Figure 6**).

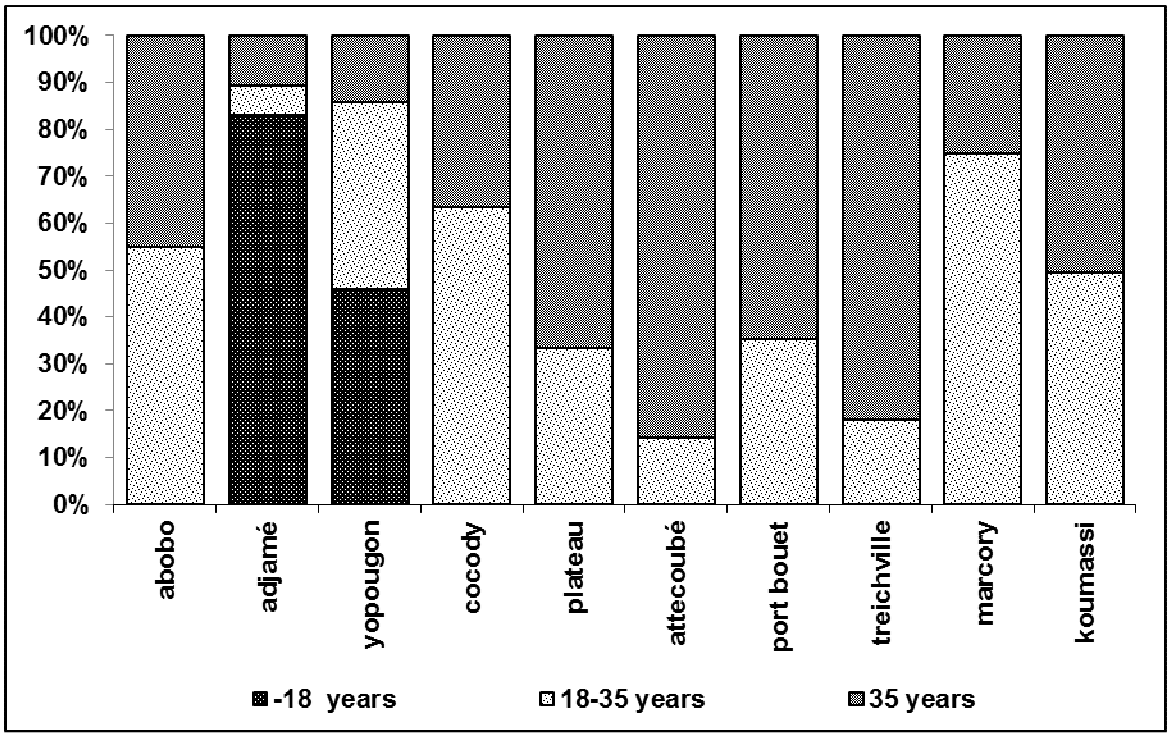


Figure 5: Distribution of retailer's snail markets Abidjan according to their age

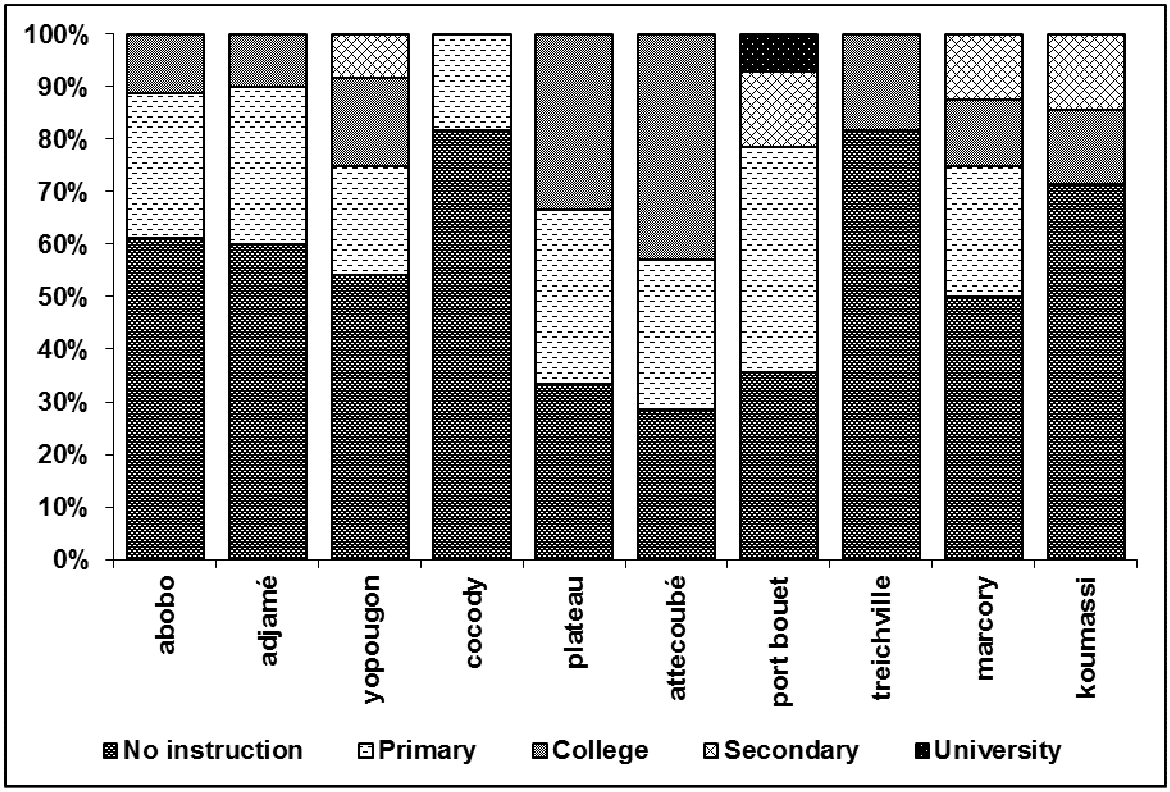


Figure 6: Distribution of retailer's snail markets Abidjan according to their level of education

Amount of snail shells and management: This study results showed an abundance of snail from the period of March to June and September to November. The deficient period when snails are rare is from December to February and July to August. During the abundance period, a retailer buys per week, on average 5.77 ± 3.50 bags against 3.28 ± 2.18 snail bags on average during the deficient period. The retailers who buy a lot are those of Yopougon with 9.04 ± 4.55 bags in average per week during the period of abundance while during the deficient period , it is the retailers of Adjamé who are most active with in average 6.30 ± 1.95 bags of snails (**Table 1**). Snails bought and sold by retailers are all forms (small, medium and large). The quantities of snails sold by retailers are positively correlated with those bought at whatever period. When selling to consumers, a large part of the retailers (97%) remove the flesh from the shell of the snail, but 3 % among them sell to consumers without removing the shell. However, almost, all the retailers interviewed (84.8 %) say that they get rid of empty shells in the dustbin after removing the flesh. A few of them (15.2%) give some of these shells, without payment, to craftsmen and women to use for decoration and traditional medical care. Empty shells are thrown in the dustbin of different markets either by retailers themselves (62 %) or carriers (43%) for remuneration. Propensity sanitation of empty shells after-sales depends on the level of education of retailer sellers. Those who have received little education are more sensitive to environmental problems caused by the management of empty shells (Figure **7**). The observations also showed that 83.3% of the retailers are not aware of the recycling of empty snail shells against 16.7% who have no idea of any recycling of those one. The knowledge of recycling the shell in various human activities is strongly related to education and age of retailer sellers. These uses are from medical care (72.7%) and decoration (9.1%) (**Figure 8 a** and **b**). The results have not mentioned the use of empty snail shells in the field of agronomy.

Table 1: Average weekly amount of bags snail (shells) available in the markets of Abidjan

Parameters	Cities of detailed selling												
	Abo	Adj	Yop	Coc	Pla	Att	Por	Tre	Mar	Kou	**GA**	**F**	**P**
QPPA	2,94±0,87^{a}	8,90±2,47^{c}	9,04±4,55^{c}	3,36±1,14^{a}	2,67±0,58^{a}	4,93±0,73^{b}	6,79±1,89^{b}	6,45±2,54^{b}	3,00±1,20^{a}	4,57±2,50^{b}	5,77	2,84**	0,0050
QSPA	2,39±0,87^{a}	8,00±2,49^{c}	7,58±4,21^{c}	2,55±1,27^{a}	2,00±0,00^{a}	4,29±0,64^{b}	5,14±2,00^{b}	4,36±2,20^{b}	2,50±0,89^{a}	4,00±2,50^{b}	4,71	2,85*	0,01
QPEP	1,94±0,64^{a}	6,30±1,95^{c}	5,17±2,65^{c}	3,00±2,13^{b}	1,83±0,29^{a}	2,64±0,85^{b}	3,32±1,14^{b}	2,18±0,75^{a}	1,31±0,37^{a}	2,39±1,35^{a}	3,28	2,98**	0,007
QSEP	1,72±0,65^{a}	6,00±1,65^{c}	4,54±2,51^{a}	3,09±2,32^{b}	1,00±0,00^{a}	2,21±0,99^{b}	2,82±1,41^{b}	2,09±0,74^{a}	1,13±0,23^{a}	1,82±0,93^{a}	2,88	3,5**	0,0025

Abo : Abobo ; Adj : Adjamé ; Yop : Yopougon ; Coc : Cocody ; Pla : Plateau; Att: Attécoubé ; Por : Port Bouet ; Tre : Treichville ; Mar : Marcory ; Kou : Koumassi ;
GA : General Average; QPPA : Quantity (bags) purchased snails per week during the period of abundance; QSPA : Quantity (bags) of snails sold per week during the period of abundance; QPEP : Quantity (bags) purchased snails per week during the deficient period; QVPC : Quantity (bags) of snails sold per week during the deficient period.
* : significative difference ;
a, b, c : Means followed by the same letter on the same line are not statistically different according to the test t of Fischer.
Period of abundance: March to June and September to November
Deficient period: December to February and July to August

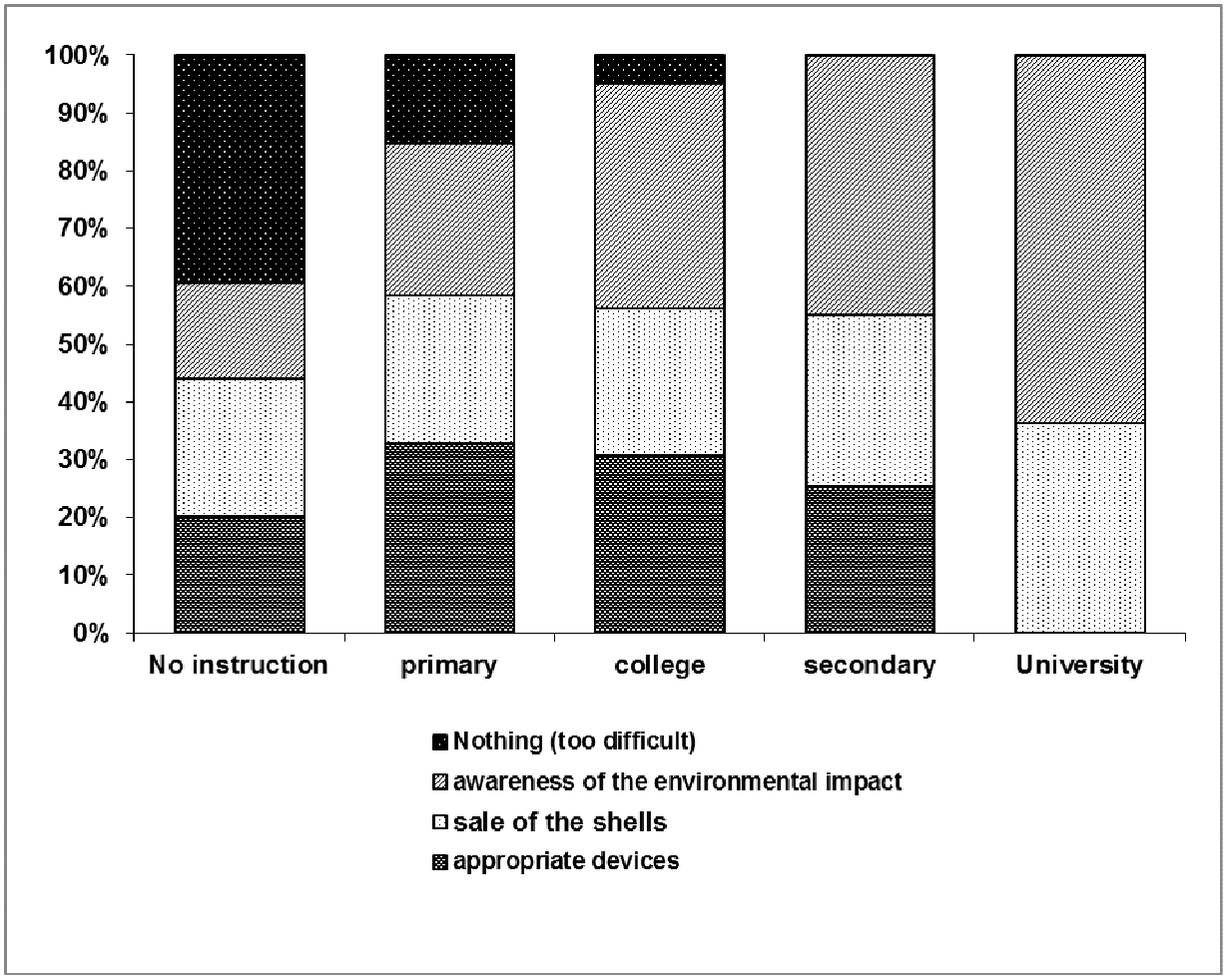
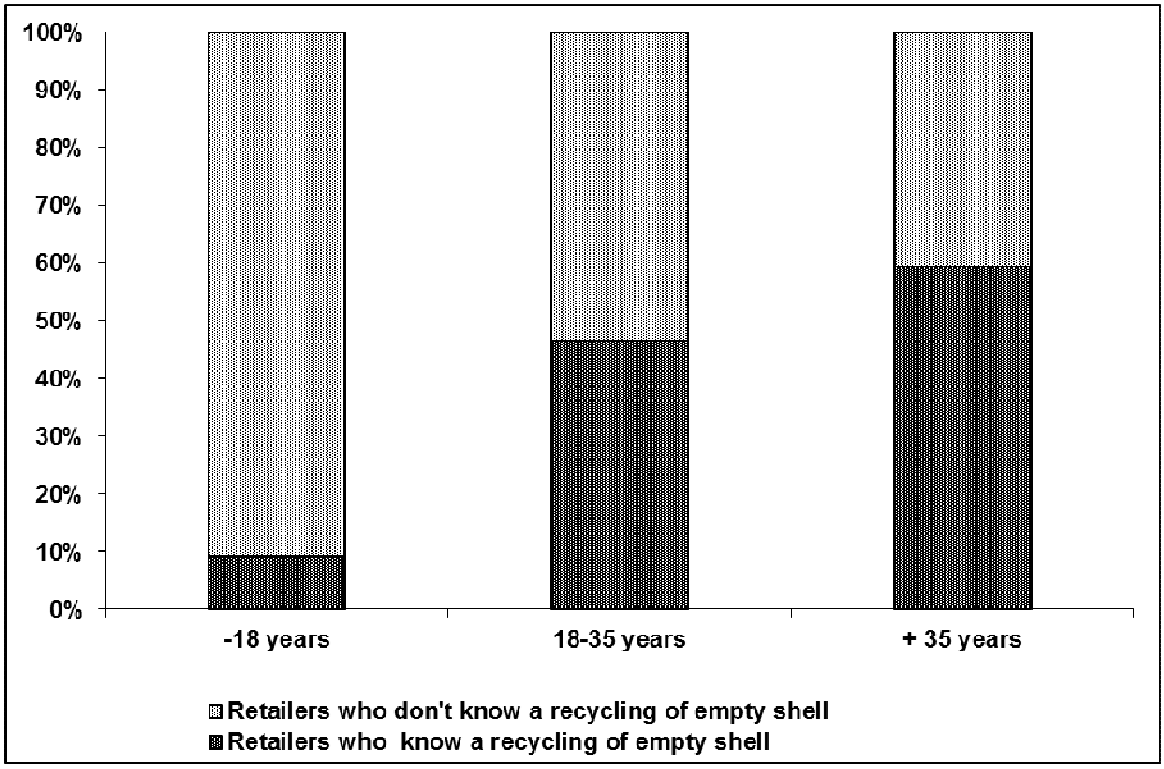
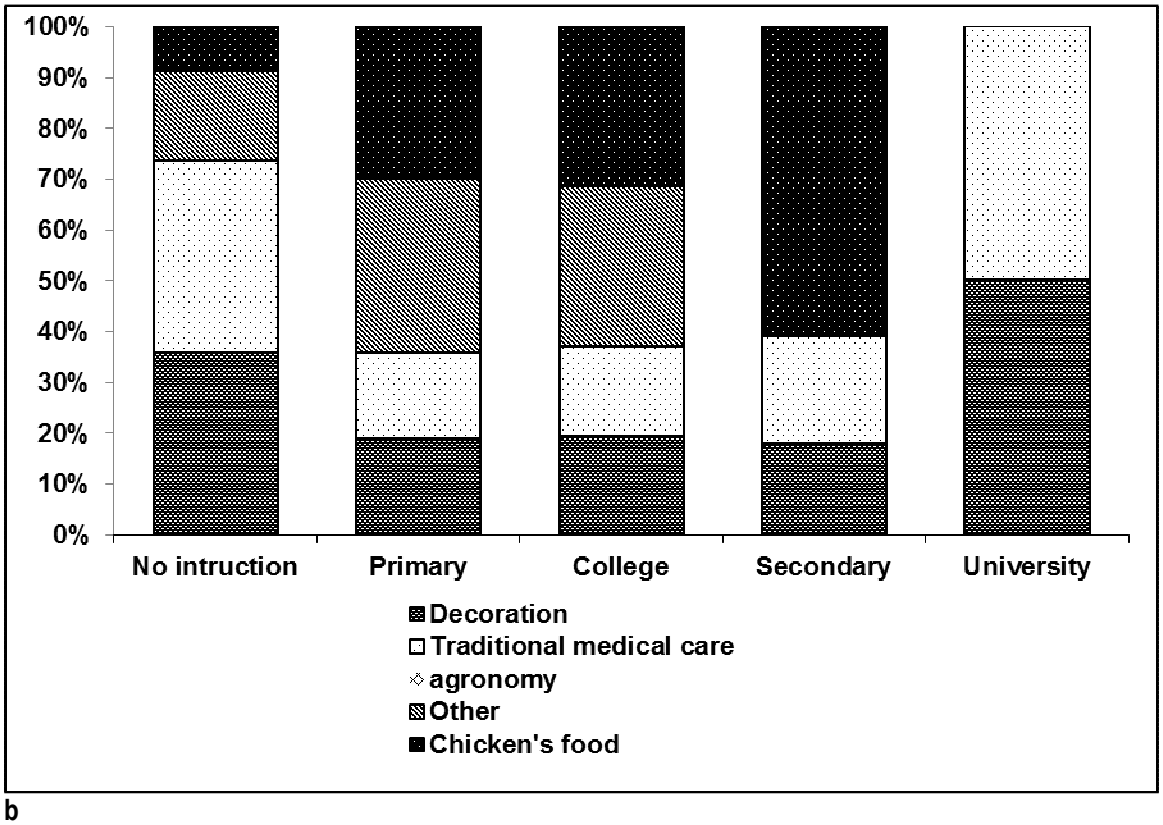


Figure 7: Encouraging sanitation empty shells after the sale



a



b

Figure 8: Knowledge enhancement empty snail shells depending on the age level (a), the level of education and use (b).

DISCUSSION

The snail trade is practiced in all the food markets of Abidjan. This activity is exclusively performed by women because it fits easily into the channels of commerce of food as observed (Sodjinou et al., 2002). These women are adults of all social strata, non-educated to university diploma holders. They engage in

this activity, often, since adolescence with aunts with whom they have been learning snail trade. To reach the final consumer, the snail go through the collectors, wholesalers and retailers. The general scheme of marketing snail is almost the same as those of rattan and leaves of *Lippia multiflora* (Zoro Bi and Kouakou, 2004; N'guessan and Yao Kouame, 2010;). The sector is still handcrafted in Abidjan, unlike other African cities as Antananarivo in Madagascar where processing units produce canned snail and Bangui in the Central African Republic (Mbétid - Bessane, 2006). Snails are collected from the forests, packed in nylon bags and transported to the city of Abidjan. This circuit is the same as described by (Cobbinah *et al.*, 2008). The snails species sold in the markets of Abidjan are *A. achatina* and *A. ventricosa*. The significant presence of the species *A. achatina* in period of abundance is explained by the strong preference of the consumers. Then, the presence of *A. ventricosa* in the deficient period finds its meaning in the high cost of purchasing *A. achatina*. Thus, for profit, retailers focus on *A. ventricosa* for which the financial productivity over the period is higher than that of *A. achatina*. The crippled Snails farming (modern snail breeding) is explained by the lack of breeding facilities and by the reluctance of consumer to farming animals. Retailers who do not know how to pick the animal could also be partly supplies from wholesalers or farmers of breeding snails.

The quantities of snails available on the markets of Abidjan (average 54.3 bags per year and per retailer) have increased but remain statistically the same as those determined by Kouassi *et al.* (2008) which was 48.84 per bag clerk retailer per year. This ratio provides an annual amount of estimated 1900 tons of retail snail markets in Abidjan. However, this amount is still insignificant compared to the large population of Abidjan, which consider the snail meat as a luxury because of the high price (between 3000 to 5000 FCFA per kilogram). The amount of snail available (1900 tons) produces about 600 tons of empty shells, shell, representing one third of the weight of the animal (Cobbinah et al. 2008). All these shells are thrown without sanitation due to the lack of conventional remediation methods, the difficulty of traditional removal of residues of the conical part of the animal and the lack of incentives (financial and environmental). However, sellers who have received formal education are more sensitive to the recycling of shells made by education in high schools and colleges on the protection of the environment. This consolidation , if done correctly will create better conditions for storage and management of empty shells and provide an opportunity for a great use of it, especially in the diet of laying hens (Sodjinou *et al.*, 2002) .

CONCLUSION

This study has allowed us to estimate the amount of empty shells from the marketing of the snail in the city of Abidjan. This results show that the stakeholders of this activity are of all ages and all levels of education and are exclusively feminine. These snails from rainforest areas of south- western Côte d'Ivoire, to traditional harvesting and availability is related to the rainy season in these areas. Abidjan is packed with a large quantity of shells (**Figure 9**), which result from removing the flesh of the snail on the sale by the retailers, which are marginally used. Although sellers know the use of snail shells, they are thrown and represented for the sellers an extra-work and contributed a source of environmental pollution.

a **b**

Figure 9: snail packed in nylon bags (a) and empty shells (b)

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