



# Economic Analysis of Cashew Apple Value Chain within the Collines Department of Benin

Raoul Akanro<sup>1</sup>, Genaud Roméo Kede<sup>1</sup>, Marie Odile Attanasso<sup>1</sup>, Joseph Dossou<sup>2</sup>

<sup>1</sup>Laboratory of Population Dynamics and Sustainable Development, University of Abomey-Calavi, Abomey-Calavi, Bénin

<sup>2</sup>Laboratory of Bioengineering of Food Processes, University of Abomey-Calavi, Abomey-Calavi, Bénin

Email: akanroar@yahoo.com

**How to cite this paper:** Akanro, R., Kede, G.R., Attanasso, M.O. and Dossou, J. (2022) Economic Analysis of Cashew Apple Value Chain within the Collines Department of Benin. *Open Access Library Journal*, 9: e9402. <https://doi.org/10.4236/oalib.1109402>

**Received:** October 1, 2022

**Accepted:** October 23, 2022

**Published:** October 26, 2022

Copyright © 2022 by author(s) and Open Access Library Inc.

This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Open Access

## Abstract

This study aims at providing an economic analysis of the valorisation of cashew apples as a means of significantly improving the income of the actors of this value chain in Benin. The sample of our study covers 110 participants and 30 groups in the cashew apple value chain within the Collines department during the 2020-2021 season. In terms of methodological approach, indicators of financial profitability of processing units were estimated. The results of this study reveal that on average, the income derived from cashew apples harvesting contributed to a 6% reduction in poverty of the harvesters. Poverty levels of the cashew apple juice traders reduced by 3.36% as a result of the income generated from the sale of the produce. Finally, processors of the cashew apples have sufficient income to take them out from below the poverty line with 135.8% reduction in poverty. Furthermore, we noted that 71% of the apple juice produced in the Collines department is exported to WAEMU countries, France, Germany and Israel.

## Subject Areas

Agricultural and Natural Resource Economics

## Keywords

Value Chain, Poverty Line, Profitability Indicators, Cashew

## 1. Introduction

Agriculture contributes to food and nutrition which promotes the socio-economic stability of the world and especially that of developing countries. The contribu-

tion of the agro-food and agro-industrial sector to the GDP of developing countries is estimated at more than 20% [1]. The cashew tree is produced primarily for its nut, but this tree also provides the apple to which the nut is attached [2] which rots in fields in Africa without a proper valorization [3].

In West Africa, very little interest is given to cashew apple processing [4]. The proportion of cashew apple processing in Benin is very insignificant. Indeed, the work of [5] revealed that less than one percent of cashew apples are processed in Benin. According to these authors, the producers who sell cashew apples have an additional annual income of 200,000 CFA francs and the cashew apple processing units have a positive performance which testifies to the richness of this value chain for the stakeholders in the cashew sector in Benin. In addition to this economic potential of cashew apples, the apple contains 85% of juice rich in sugars, vitamin C and minerals. These nutritional values contribute to stable food security in developing countries such as Benin [6]. Apple juice production remains very low and is not adopted by processors. Indeed, traditional historical considerations on the conflict between the consumption of cashew apples and milk [7], the difficulties encountered in the preservation of the apple and the limited access to financial resources that give access to sophisticated technologies [8], are indicators of the low processing of apple into juice.

The value chain concept finds its basis in the work of [9]. Seeking to promote the competitiveness of companies, [10] postulates that the objective of the value chain is to analyze the main activities that allow companies to create added value and increase their competitive advantages.

The literature in general has focused on the summary state of the derivatives obtained from the valuation of the cashew apple, but to our knowledge, very few studies provide information on the economic benefits of the valuation of cashew apples. One of the few works that have addressed the economic aspect of the valuation of cashew apples remains the work of [11] in Nigeria. However, this author did not deal exclusively with the added value of cashew apple, but he cumulated the added value of the nut and processed cashew apple in plantations in Nigeria.

The present study therefore aims to fill the gap in the literature in this sense by exclusively taking into account the processing of the cashew apple. It seeks to determine on the one hand the value added to the transformation of cashew apple into juice by each actor and on the other hand the different marketing circuits of the apple juice produced in the hills department in Benin.

This paper is structured as follows: After the presentation of the methodology adopted, we present and discuss the results of our estimates, then come the conclusion and public policy recommendations.

## **2. Methodology**

### **2.1. Study Area**

An exploratory survey allowed us to identify the existence of about forty cashew

apple processing units in Benin. These units are distributed in the departments of Collines (17 units), Borgou (10 units), Donga (6 units) and Atacora (7 units). This study took place in the department of Collines where the processing of cashew apples first began in Benin. In addition, it houses nearly half of the existing cashew apple processing units in Benin.

The department of Collines belongs entirely to the Sudano Guinean climate zone marked by two rainy seasons which cover the periods from April to July and from October to November. It is a transition zone (between the South and the North) of 16,900 km<sup>2</sup> which extends after the plateau of Abomey and that of Kétou to the 9th parallel north. This area is entirely occupied by leached or impoverished tropical ferruginous soils. These characteristics are very favorable to cashew cultivation. This department has six municipalities which are Dassa-Zoumé, Savalou, Bantè, Savè, Glazoué and Ouèssè (Figure 1).

### 2.2. Sampling

This study concerns the seventeen (17) existing processing units in the Collines department. Cashew apple collectors and traders were surveyed by the snowball method (Table 1).

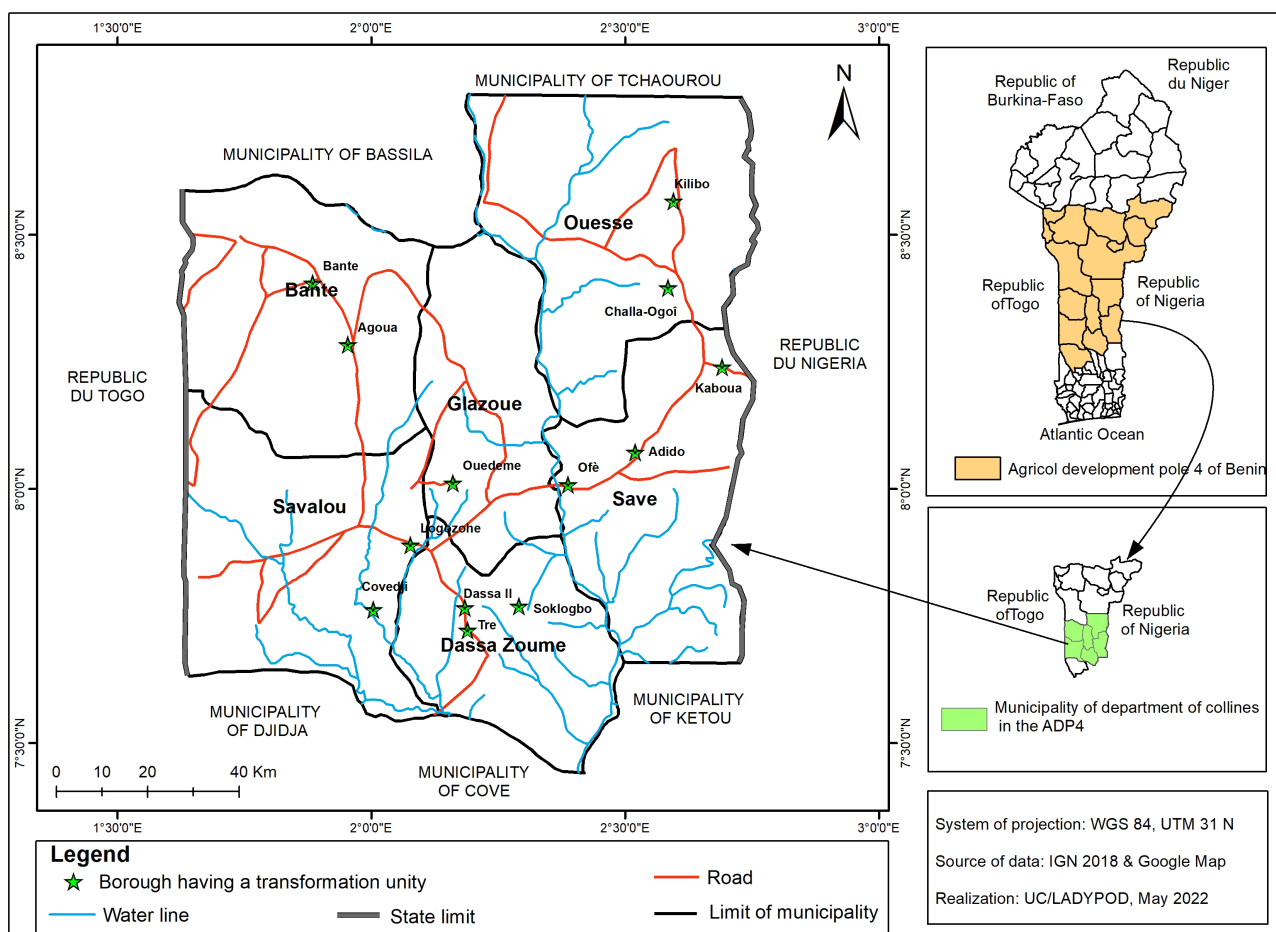


Figure 1. Distribution of the observation units in the Collines department.

**Table 1.** Distribution of actors along the value chain.

Value chain actors	Individual participants	Groupings
Cashew harvesters	78	0
Transformation units	2	15
Cashew juice local traders	30	15
Cashew harvesters	78	0
Total	110	30

The number of individual actors represents the sum of the individuals working alone. The number of actors along the chain ( $n_{op}$ ) is the number of individuals involved in the same activity.

### 2.3. Data Collection

- **Destination of the juice produced in the observation units**

The ArcGIS software was used to map the sales channels of the juice produced and to determine the different destinations of this juice inside and outside Benin.

- **Estimation of the financial profitability indicators of the value chain**

The average cost of processing apple into juice ( $C_t$ ) according to the [12] formula

$$C_t = \left[ \sum_1^{n_{op}} \left( (C_{fp} + C_{vp}) / Q_t \right) i \right] / n_{am} \quad (1)$$

With

$C_{fp}$  = the fixed cost of production;

$C_{vp}$  = the variable cost of production;

$Q_t$  = the quantity of apple processed into juice per processing unit;

$(C_{fp} + C_{vp}) / Q_t$  = the average production cost per unit into juice;

$n_{am}$ : the number of actors per link;

$i$ : an actor.

**The average unit marketing cost ( $C_c$ )** was calculated similarly

$$C_c = \left[ \sum_1^{n_{am}} \left( (C_{fc} + C_{vc}) / Q_c \right) i \right] / n_{am} \quad (2)$$

With

$C_{fc}$  = the fixed cost of marketing;

$C_{vc}$  = the variable cost of marketing;

$Q_c$  = the quantity of juice marketed by each unit;

$C_c$  is expressed in FCFA/liters.

**The average apple harvesting cost ( $C_h$ )** was calculated similarly

$$C_h = \left[ \sum_1^{n_{am}} \left( (C_{fh} + C_{vh}) / Q_{ch} \right) i \right] / n_{am} \quad (3)$$

With

$C_{fh}$  = the fixed cost of harvesting;  
 $C_{vh}$  = the variable cost of harvesting;  
 $Q_{ch}$  = quantity of juice marketed by each unit;  
 $C_h$  is expressed in FCFA/liters.

The costs consist only of the variable harvesting and marketing costs (fuel, travel costs). Equation (2) becomes:

$$C_c = \left[ \sum_1^{n_{am}} (C_{vc}/Q_c) i \right] / n_{am} \quad (4)$$

Equation (3) becomes:

$$C_h = \left[ \sum_1^{n_{am}} (C_{vh}/Q_{ch}) i \right] / n_{am} \quad (5)$$

The margin ( $M_t$ ) from the processing of the cashew juice is established according to the Springer-Heinze relationship (2018)

$$M_t = P_v - C_j \quad (6)$$

Where,

$P_v$  is the unit selling price of the product.

$C_j$  is the cost of the corresponding value chain link.

The margin ( $M_p$ ) from the cashew marketing was calculated using:

$$M_p = P_v - C_p \quad (7)$$

The margin ( $M_j$ ) from the marketing of cashew juice was calculated using:

$$M_j = P_v - C_h \quad (8)$$

The rate of profitability ( $r$ ) is obtained by the formula:

$$r = \frac{M}{P_v} \times 100 \quad (9)$$

$$I = Q_p \times M \quad (10)$$

$I$ : Income which is expressed in FCFA;  $M$  is the production or marketing margin. The contribution of income to the reduction poverty ( $C_p$ ) is established by:

$$C_p = \frac{I}{S_p} \quad (11)$$

$S_p$  is the reference poverty line for the year the data was collected, which was 1,401.73 FCFA/day or 504,622.8 FCFA per adult person/year in 2022 [13].

#### • Estimation of economic performance indicators of the Value chain

The employment created by the CV, is expressed by:

$$E = (N \times T_m) / 8$$

- $T_m$  is the average time (h) devoted to the activity, adjusted for the quantities produced. Eight hours of work were considered to correspond to one working day.  $E$  is expressed in working days (jt).
- The income of a link in the value chain is obtained by multiplying the income received by each direct actor by the number of actors in the link

considered. Thus, the total income of the Value Chain was obtained by summing the income of all the different links in the chain.

- the added value created by all the players at each step of the value chain is estimated using the following formula from [14]:

$$VA = CA - CI$$

CA represents the revenue in FCFA; CI, the intermediate consumption in Fcfa.

The total value added was obtained by summing the value added of all the links.

### 3. Results

#### 3.1. Description of the Cashew Apple Value Chain in Benin

Cashew apples are collected from cashew plantations to be processed into juice, syrup, wine and liquor. This activity is carried out by harvesters and processing units. Most processing units have rolling stock called tricycles that allow them to go from farm to farm in order to buy selected apples from harvesters. The purchased apples are transported to the processing units in the villages and towns of the various communes of the Collines department where these apples are transformed after a process that generally last for 10 hours. The juice is then sold in the city centers of Benin and is also exported outside Benin.

#### 3.2. Value Added to Cashew Apple Juice by Actors in the Cashew Apple Value Chain

**Table 2** below shows that the harvesting of the cashew apples has the highest profit margin with a profitability of 86.66%, followed by the apple juice processing which boast of profitability of 76.75% and the actual commercialisation of apple juice is the activity which has the smallest profit margin with a profitability of 15.64%. This is generally due to the fact that there is less cost involved in the harvest of the apples as compared to processing and marketing.

**The values in brackets represent standard error**

A look at the contribution of each stage in reducing poverty (**Table 3**) shows that a harvester would see his/her poverty level reduced by almost 6%, while a trader would see his/her poverty level reduced by 3.38%. Finally, players at the

**Table 2.** Margins of participants and profitability of products at each step of the cashew apple juice value chain.

Link in the Value chain	Sale price (FCFA)	Average Cost of Production/Marketing (FCFA)	Margin (FCFA)	Profitability
Cashew harvest (per kg)	19.28 (0.56)	0.23 (0.04)	17.05 (3.10)	86.66
Cashew juice processing (per l)	1473.16 (543.10)	614.12 (152.34)	859.03 (408.54)	76.75
Local Marketing of the juice (per kg)	1200 (0)	1037.26 (143.98)	162.72	15.64

processing stage see the most benefits as their poverty level reduce by a staggering 135.80%. Hence, we noted that the activity of processing cashew apples makes it possible to completely move from below the poverty line.

In terms of employment potential (**Table 4**), the cashew apple value chain in the Collines department mobilized at least 14,461 working days (JT) for a production of 5888 liters of apple juice in 2021; the processing activity created more jobs with a contribution of 12,875 working days. Overall, the current income and added value received by all actors are 146647571.7 and 123,269,874 FCFA respectively.

### 3.3. Distribution of Cashew Apple Juice Produced in the Processing Units

The analysis of **Figure 2** below reveals that in 2021, 13% of the cashew apple juice produced in the Collines department in Benin was consumed in the Southern of the country, 6% was consumed in the North and 10% in the Central regions of the country. In addition, 20% of the juice was exported to WAEMU countries such as Burkina-Faso, Niger, Togo and Senegal. In Europe, 23% of the juice produced was consumed in France and 9% in Germany. The remaining 19% was consumed in Asia, mainly in Israel. In short, 71% of the cashew apple juice produced in the Collines department is exported to WAEMU, European and Asian countries. France is the biggest consumer of the cashew juice outside of Benin.

**Table 3.** Contribution to poverty reduction of participants in the value chain.

Link in the value chain	Contribution to poverty reduction (%)
Harvesting of the cashew (per kg)	5.99
Processing into juice (per l)	13,580
Commercialisation of the juice (per kg)	3.38

**Table 4.** Jobs creation and contribution of the apple processing value chain to income and the adding of value to the participants.

Activity	Jobs	Intermediate Consumption (FCFA)	Participants Income (FCFA)	Value Added (FCFA)
Harvesting	1485	0	2328755.04	2328755.04
Processing	12,875	23,377,698	143,807,000	120,429,302
Local Trade	101	0	511816.6677	511816.668
Cashew apple juice value chain	14,461	23377.698	146647571.7	123,269,874

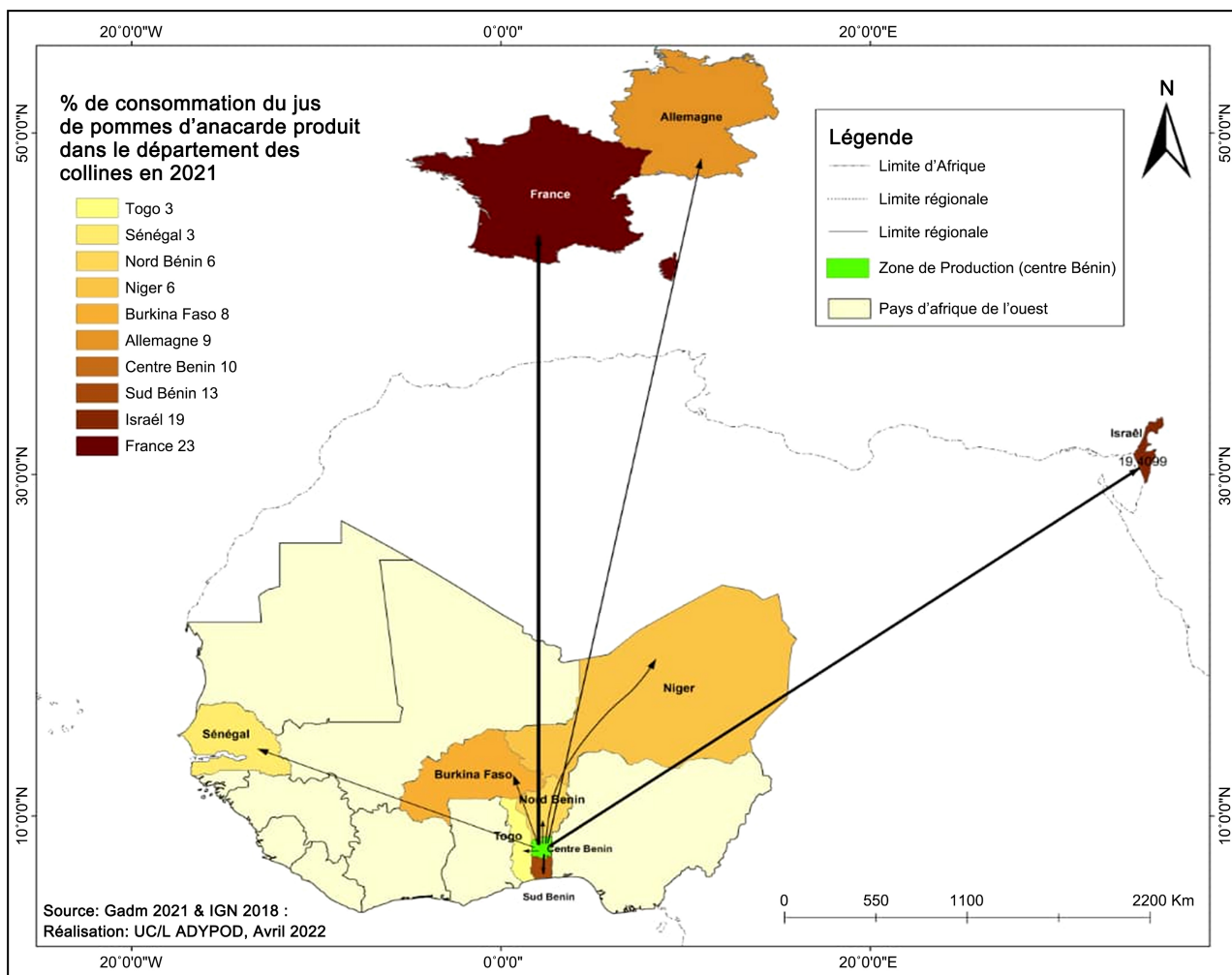


Figure 2. Sales channel of the cashew apple juice produced in the Collines department in Benin.

#### 4. Discussion

The juice produced in the Value Chain has enabled the participants to earn positive margins. The price at which each participant sold the product allowed them to make a profit. The cashew apple processing activity is economically profitable. Work carried out in Togo by [15] on tamarind value chain resulted in a margin of 22 per cent for the Marketing of the juice. Comparatively, the margin of 15 per cent generated by the marketing of cashew apples is lower. This is because tamarind is a familiar product with a developed marketing chain unlike cashew juice. The positive margins generated by all the participants allowed them to contribute to the reduction of monetary poverty in the Collines department. While the harvesting and merchant links contribute little to the reduction of monetary poverty (less than 10%), the processing link completely falls outside the monetary poverty line (135.80%). This last result is conformed with work of [16] and is higher than that of [17] which found a monetary poverty reduction threshold of 33% in baobab juice value chain.

The export rate of 71% of apple juice produced in the Collines department is



similar to that of pineapple export crop produced in Benin. Indeed, the work of the National Institute of Statistics and Economic Analysis [18] reveals that 80% of the fresh and dried pineapple produced in Benin is exported. In addition, the proportion of cashew apple juice sold on the local market, which is 29%, is higher than that of pineapple juice and syrup sold on the local market. According to [18], 15% of pineapple juice and syrup are sold on the local market in Benin. However, holding everything else constant, the quantity of cashew apple juice produced in Benin is insignificant compared to the quantity of pineapple juice produced. It should be noted that the 15% of pineapple juice consumed is more than the 29% of apple juice consumed in quantity. There is still a long way to go to achieve sufficient valorisation of the cashew apple in Benin.

After the text edit has been completed, the paper is ready for the template. Duplicate the template file by using the Save As command, and use the naming convention prescribed by your journal for the name of your paper. In this newly created file, highlight all of the contents and import your prepared text file. You are now ready to style your paper.

## **5. Conclusions and Suggestion**

This study analyzed the economic valorisation of cashew apples into juice in the Collines department in Benin. More clearly, the study determined the real impact of the value chain and its contribution to poverty reduction. Although the highest profit margin in the cashew apple value chain is realised at the harvesting level, harvesters end up with the lowest income in the value chain. In addition, the study of the sales channel of cashew apple juice produced in the Collines department has revealed that the product is mainly consumed beyond Benin's borders.

At the end of this study, we suggest that the actors of the cashew apple value chain get together in order to work out a fairer distribution of the income from the Value Chain. We also encourage cashew apple processing units to standardize the juice obtained in order to obtain the protection against the collective mark of apple juice on the one hand and to obtain cost reduction advantages for export cashew apple juice. Government support is also necessary to meet the challenges related to the non-valorization of cashew apples in Benin.

## **Acknowledgements**

We thank Technoserve for its financial support. We are also grateful for the help provided by Mr. N'DJOLASSE Kouami, Head of the Cashew nut program in Benin, Mr KODJO Siaka, director of the PADEFA-ENA project, HOUNKPE Anago Grace, Manager of the Response office and the cashew nut sector actors of the Collines Department in the realization of this work.

## **Conflicts of Interest**

The authors declare no conflicts of interest.

## References

- [1] Ojuku, T. (2022) Dynamics of Ndu and Tole Agro-Industries and Outcomes on Rural Development in Northwest and Southwest Regions of Cameroon. *European Journal of Education and Pedagogy*, **3**, 17-25.  
<https://doi.org/10.24018/ejedu.2022.3.3.302>
- [2] Notebaert, C. (2019) Systemealimentaire et politiques agraires a l'ombre des pommiers-cajou: Les dynamiquesagraires et alimentairesliees a l'anacardier dans le nordeste du Brésil (sistemaalimentar e políticaagrarias sombras dos cajueiros: As dinâmicasagrarias e alimentaresligadasaocajueiro no nordeste do Brasil). *Revista GeoNordeste*, **2**, 6-19.  
<https://doi.org/10.33360/RGN.2318-2695.2019.i2especial.p.6-19>
- [3] Aboh, A., Dougnon, J., Atchade, G. and Tandjiekpon, A. (2012) Effetd'aliments à base de pommecajou sur les performances pondérale et la carcasse des canetonsencroissance au Bénin. *International Journal of Biological and Chemical Sciences*, **5**, 2407-2414. <https://doi.org/10.4314/ijbcs.v5i6.20>
- [4] Dossou, *et al.* (2019) Etude des performances techniques d'un filtre-presse pour la filtration du jus de pommed'anacarde (*Anacardium occidentale* L.). *African Journal of Food, Agriculture, Nutrition and Development*, **19**, 14690-14707.  
<https://doi.org/10.18697/ajfand.86.17380>
- [5] Kouassi, E. (2018) Contribution à la valorisation des sous-produits agricoles en bioproduits.
- [6] Dèdèhou, *et al.* (2015) Etude diagnostique des technologies de transformation de la pomme de cajouen jus au Bénin. *International Journal of Biological and Chemical Sciences*, **9**, 371-387. <https://doi.org/10.4314/ijbcs.v9i1.32>
- [7] Lacroix, E. (2003) Les anacardiens, les noix de cajou et la filièreanacarde à Bassila et au Bénin. *Projetrestauration des ressourcesforestières de Bassila, Bassila*, 75 p.
- [8] Adou, M., Adjouman, Y.D., Kouadio, K.O. and Tetchi, A.F. (2021) Improvement of Cashew Apple Juice (*Anacardium occidentale* L.) by Association with Passion Fruit Juice (*Passiflora edulis*). *Food and Nutrition Sciences*, **12**, 787-804.  
<https://doi.org/10.4236/fns.2021.127059>
- [9] Porter, M. (1985) *From Competitive Advantage to Corporate Strategy*. 22.
- [10] Porter, M. (1980) *Competitive Strategy: Techniques for Analyzing Industries and Competitors*. Free Press, New York.
- [11] Lawal, J., Oduwole, O., Shittu, T. and Muiyiwa, A. (2011) Profitability of Value Addition to Cashew Farming Households in Nigeria. *African Crop Science Journal*, **19**, 49-54. <https://doi.org/10.4314/acsj.v19i1.68659>
- [12] Springer-Heinze, A. (2018) *ValueLinks2.0: Manual on Sustainable Value Chain Development*. Vol. 2, GIZ (Gesellschaft für InternationaleZusammenarbeit), Eschborn.
- [13] World Development (2022) *Finance for an Equitable Recovery*.  
<https://www.banquemonddiale.org>
- [14] Faße, A., Grote, U. and Winter, E. (2009) *Value Chain Analysis Methodologies in the Context of Environment and Trade Research*. Discussion Papers, Leibniz University, Hannover.
- [15] Samarou, M., Atakpama, W., Atato, A., Mamoudou, M.P., Batawila, K. and Akpagana, K. (2022) Valeur socio-économique du tamarin (*Tamarindus indica*) dans la zone écologique I du Togo. *Revue Marocaine des Sciences Agronomiques et Vétérinaires*, **10**, 272-281.

- [16] van Rayne, K.K., Adebo, O.A., Wokadala, O.C. and Ngobese, N.Z. (2022) The Potential of *Strychnos* spp L. Utilization in Food Insecurity Alleviation: A Review. *Food Reviews International*, 1-15. <https://doi.org/10.1080/87559129.2021.2012791>
- [17] Chadare, F., Hounhouigan, J., Linnemann, A., Nout, M. and Van Boekel, M. (2008) Indigenous Knowledge and Processing of *Adansonia digitata* L. Food Products in Benin. *Ecology of Food and Nutrition*, **47**, 338-362. <https://doi.org/10.1080/03670240802003850>
- [18] INSAE (2020) Monographie de la filière de l'ananas au Bénin. Institut National de la Statistique et de l'Analyse Economique.